

Graphical Representation of Data: A Practical Approach



- Rajeev Agrawal
- Priyanka Gupta

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Rajeev Agrawal

Dean

Faculty of Education

Bundelkhand University, Jhansi (UP)

And

Priyanka Gupta

M.Sc. (Botany), M.Ed.

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Rajeev Agrawal and Priyanka Gupta

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Priyanka Gupta

Civil Lines, Atarra, Distt.—Banda (Uttar Pradesh) 210201

Mob.—9305983800

E-mail—priyankaguptabpmmmv@gmail.com

Preface

Graphical Representation is a way of analysing numerical data. It exhibits the relation between data, ideas, information and concepts in a diagram. It is easy to understand and it is one of the most important learning strategies. It always depends on the type of information in a particular domain.

The main use of a graphical representation of data is understanding and identifying the trends and patterns of the data. It helps in analysing large quantities, comparing two or more data, making predictions and building a firm decision. The visual display of data also helps in avoiding confusion and overlapping of any information. Graphical Representation of data is important in communicating our findings, understanding and analysis of the data to others.

The present book throws light on various topics related to ‘Educational Research’, ‘Statistics’ and ‘Graphical Representation of Data’, The book describes types of Graphical Representation mainly: Line Graph, Bar Graph, Histogram, Pie Chart, Cumulative Frequency Curve and Frequency Polygon in detail including their uses and construction through MS Excel.

Certainly, the book will be useful for all college students and teachers specially for research scholars.

It is natural that there may be many errors in the present book. Therefore, if experienced scholars will take the trouble to inform, then we will be very grateful.

06 December, 2022

Rajeev Agrawal

Priyanka Gupta

Content

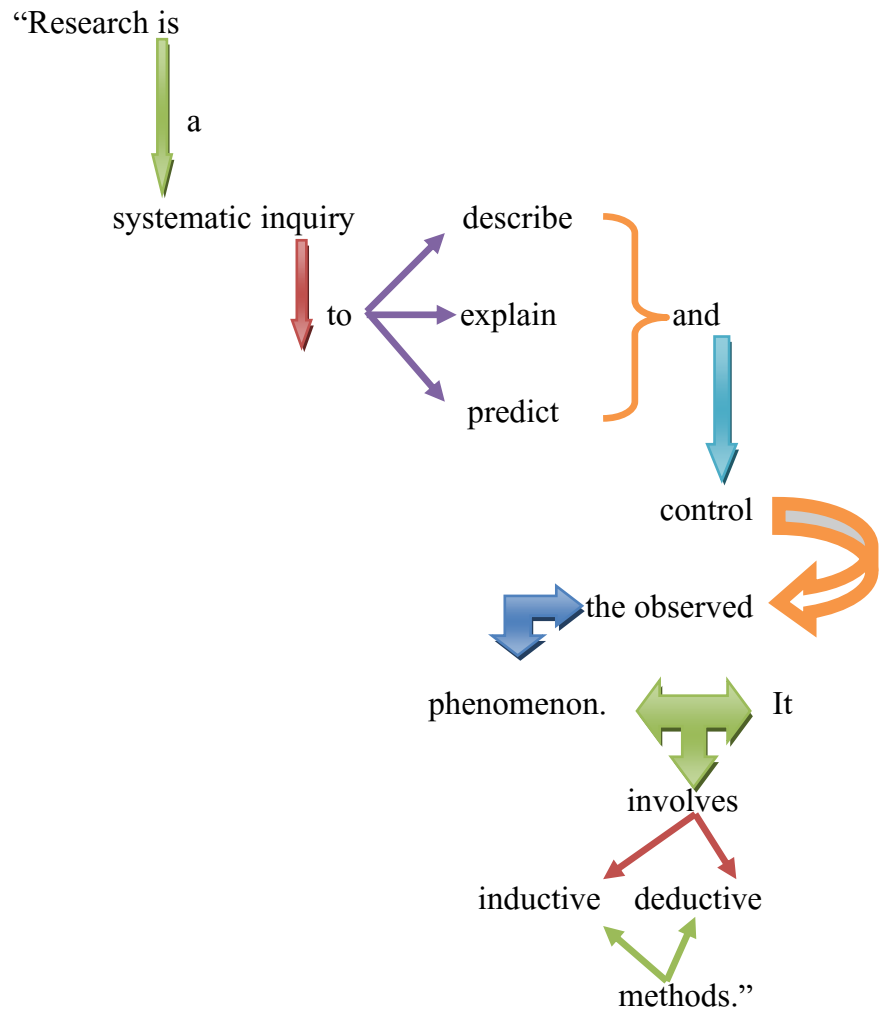
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Introduction-

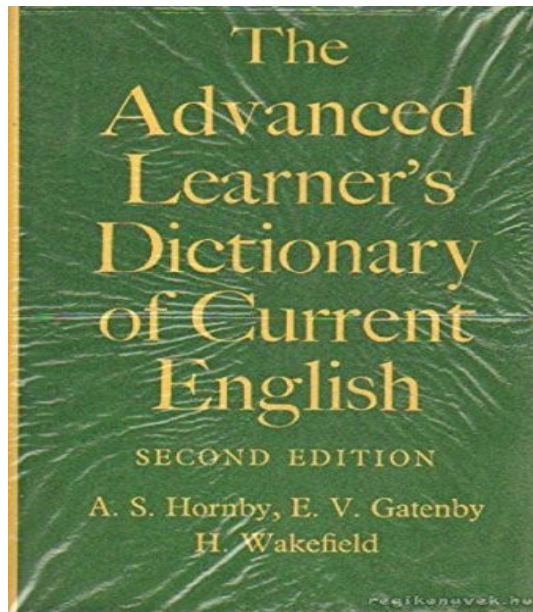
- ❖ The word 'research' originated from the old French word 'recherchier' meaning to search and search again.
- ❖ It literally implies repeating a search for something and implicitly assumes that the earlier search was not exhaustive and complete in the sense that there is still scope for improvement.
- ❖ Research in common parlance refers to a search for knowledge.
- ❖ It may be defined as a scientific and systematic search for pertinent information on a specific topic/area. In fact, research is an art of scientific investigation.
- ❖ Research has some people consider research as a movement, a movement from known to unknown.
- ❖ It is actually a voyage of discovery.
- ❖ Research is a scientific approach of answering a research question, solving a problem or generating new knowledge through a systematic and orderly collection, organization, and analysis of information with an ultimate goal of making the research useful in decision-making.
- ❖ Research is a process to discover new knowledge.
- ❖ A systematic investigation (i.e., the gathering and analysis of information) designed to develop or contribute to generalizable knowledge.

Definitions of research-

According to the American sociologist Earl Robert Babbie,



According to the Advanced Learner's Dictionary of Current English,



“A careful
↓
investigation or inquiry
↓
especially
↓
through
↓
search for new facts
↗ in
any branch of knowledge”.



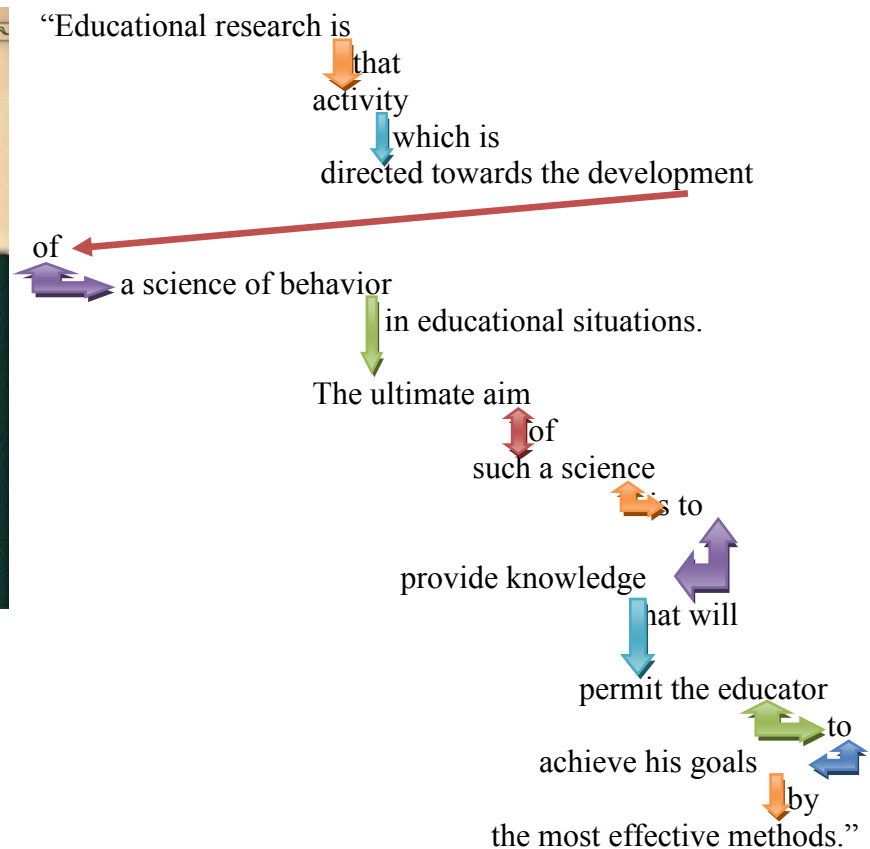
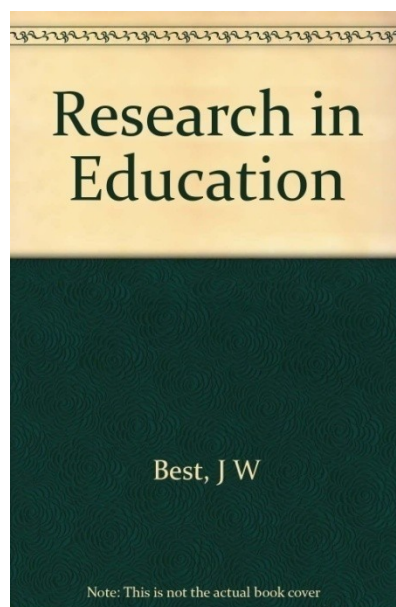
Educational research-

- ✚ Education is an integral aspect of every society and in a bid to expand the frontiers of knowledge; educational research must become a priority. Educational research plays a vital role in the overall development of pedagogy, learning programs, and policy formulation.

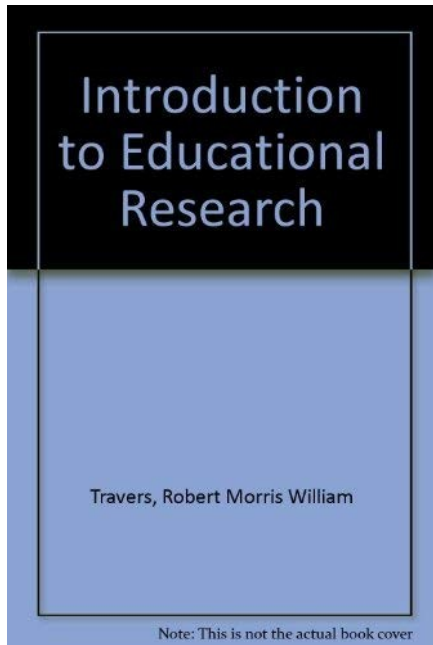
- ✚ Educational research is a spectrum that bothers on multiple fields of knowledge and this means that it draws from different disciplines. As a result of this, the findings of this research are multi-dimensional and can be restricted by the characteristics of the research participants and the research environment.
- ✚ Educational research refers to a systematic attempt to gain a better understanding of the educational process, generally with a view in improving its efficiency. It is an application of the scientific method to the study of educational problems.
- ✚ Educational research is a type of systematic investigation that applies empirical methods to solving challenges in education. It adopts rigorous and well-defined scientific processes in order to gather and analyze data for problem-solving and knowledge advancement.
- ✚ The primary purpose of educational research is to expand the existing body of knowledge by providing solutions to different problems in pedagogy while improving teaching and learning practices. Educational researchers also seek answers to questions bothering on learner-motivation, development, and classroom management.

Definitions of Educational research-

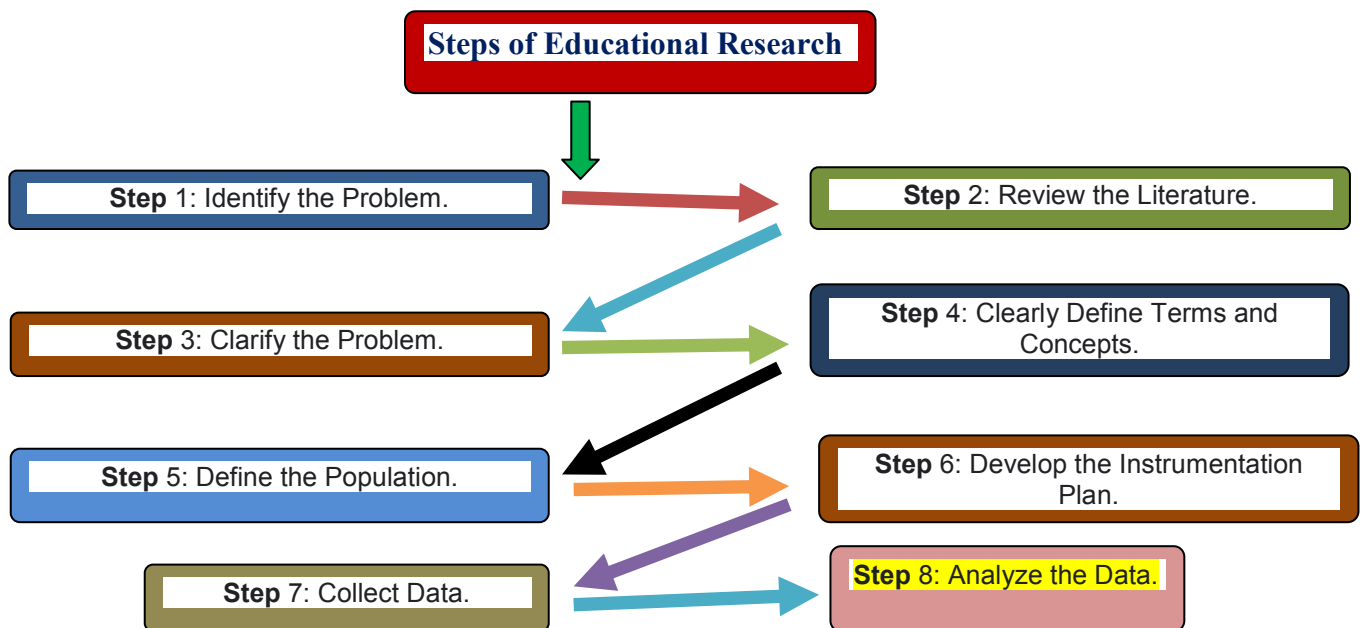
According to J. W. Best-



According to W. M. Traverse,



“Educational research is that activity which is directed towards the Development of science of behavior in educational situations.”

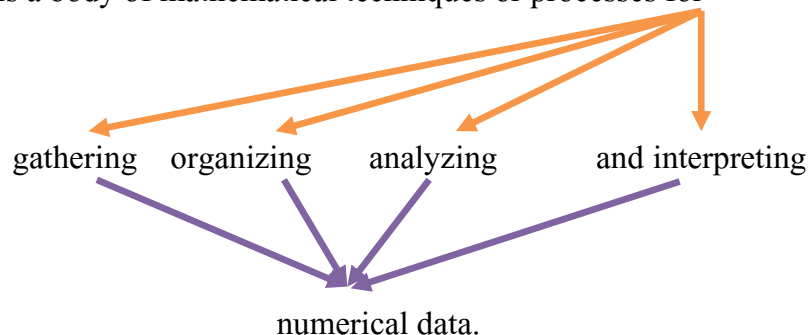


Analysis of the Data-

- ✓ After the data has been collected, the researcher needs to turn to the task of analyzing them.
- ✓ Data, in any form, are raw and neutral. Their direction and trend is generally highlighted and reflected with the help of analysis and interpretation.
- ✓ The researcher finally has data to analyze so that the research question can be answered.
- ✓ In the instrumentation plan, the researcher specified how the data will be analyzed.
- ✓ The researcher now analyzes the data according to the plan.
- ✓ The results of this analysis are then reviewed and summarized in a manner directly related to the research questions.
- ✓ Data Analysis is the process of systematically applying **statistical** and/or logical techniques to describe and illustrate, condense and recap, and evaluate data.

Statistics

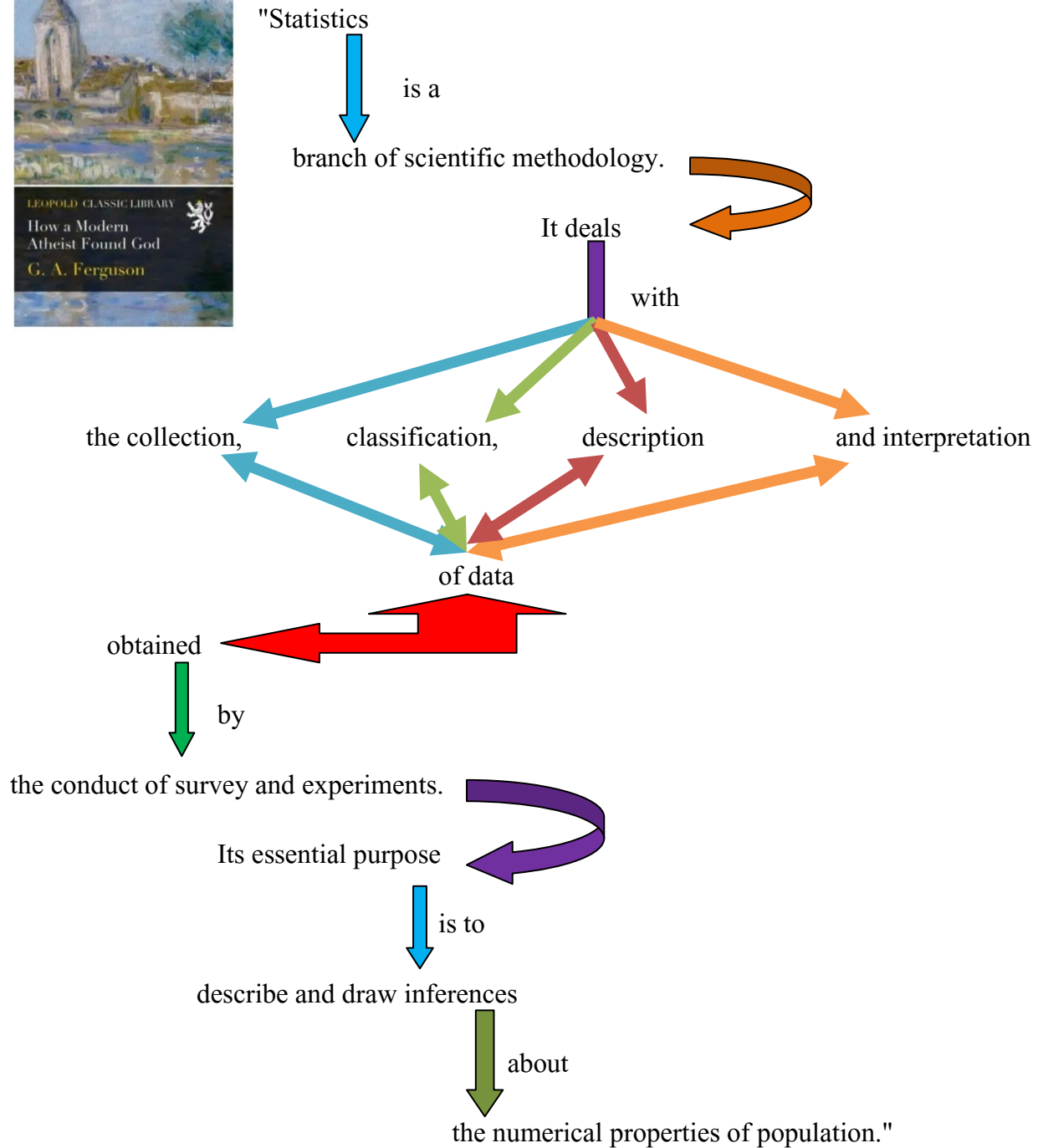
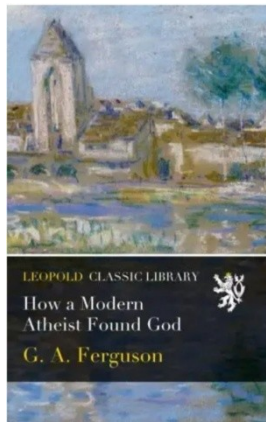
- ❖ Statistics is the body of mathematical techniques or processes for gathering, describing organising and interpreting numerical data.
- ❖ Since research often yields such quantitative data, statistics is a basic tool of measurement and research.
- ❖ The research worker who uses statistics is concerned with more than the manipulation of data, statistical methods goes back to fundamental purposes of analysis.
- ❖ Statistics is a body of mathematical techniques or processes for



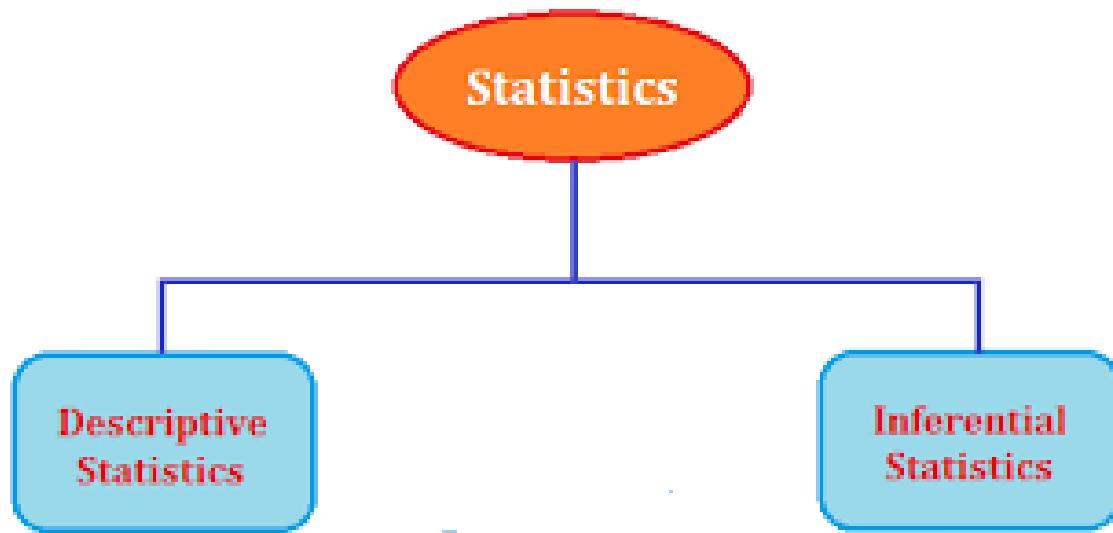
- ❖ Most research yields such quantitative data; statistics is a basic tool of measurement, evaluation, and research.
- ❖ The word statistics is sometimes used to describe the numerical data that are gathered. Statistical data describe group behaviour or group characteristics abstracted from a number of individual observations that are combined to make generalizations possible.
- ❖ The statistical measurement is an abstraction that may be used in place of a great mass of individual measures.
- ❖ The research worker who uses statistics is concerned with more than the manipulation of data.
- ❖ The statistical method serves the fundamental purposes of description and analysis, and its proper application involves answering the following questions:
 - ✚ What facts need to be gathered to provide the information necessary to answer the question or to test the hypothesis?
 - ✚ How are these data to be selected, gathered, organized, and analyzed?
 - ✚ What assumptions underlie the statistical methodology to be employed?
 - ✚ What conclusions can be validly drawn from the analysis of the data?

Definition of Statics

According to G.A. Ferguson,



Types of Statics

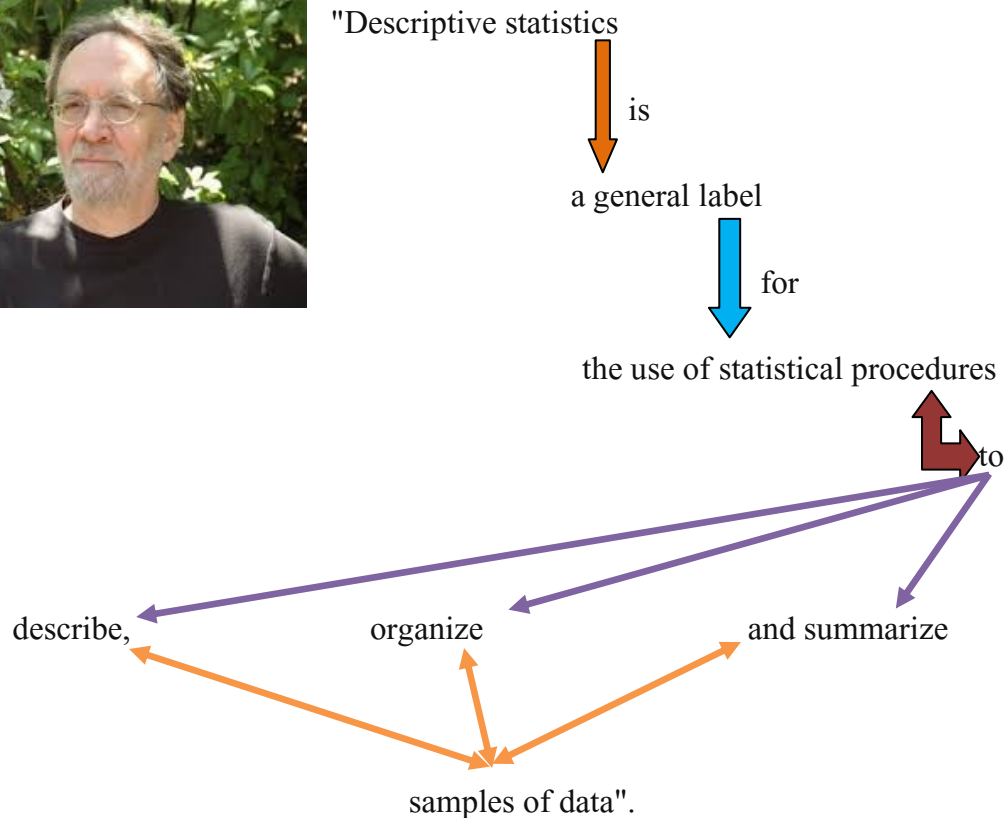


Descriptive statistics

- ❖ Descriptive statistics are brief descriptive coefficients that summarize a given data set, which can be either a representation of the entire or a sample of a population.
- ❖ Descriptive statistics are broken down into measures of central tendency and measures of variability (spread).
- ❖ All descriptive statistics are either measures of central tendency or measures of variability, also known as measures of dispersion.
- ❖ Measures of central tendency focus on the average or middle values of data sets, whereas measures of variability focus on the dispersion of data.
- ❖ These two measures use **graphs, tables** and general discussions to help people understand the meaning of the analyzed data.

Definition of Descriptive Statistics-

According to Reber & Reber,



Inferential statistics-

- ✚ Inferential statistics is one of the two main branches of statistics.
- ✚ Inferential statistics use a random sample of data taken from a population to describe and make inferences about the population.
- ✚ Inferential statistics are valuable when examination of each member of an entire population is not convenient or possible. For example, to measure the diameter of each nail that is manufactured in a mill is impractical.

Inferential statistics is a statistical method that deduces from a small but representative sample the characteristics of a bigger population. In other words, it allows the researcher to make assumptions about a wider group, using a smaller portion of that group as a guideline.

Difference Between descriptive statistics And Inferential statistics-

| DESCRIPTIVE | INFERENTIAL |
|--|---|
| It is the analysis of data that helps to describe, show and summarize data under study | It is the analysis of random sample of data taken from a population to describe and make inference about the population |
| Organize, analyze and present data in a meaningful way | Compares, test and predicts data |
| It is used to describe a situation | It is used to explain the chance of occurrence of an event |
| It explain already known data and limited to a sample or population having small size | It attempts to reach the conclusion about the population |
| Types: Measure of central tendency & Measure of variability | Types: Estimation of parameters & Testing of hypothesis |
| Results are shown with help of charts, graphs, tables etc. | Results are shown with help of probability scores |

Graphical Representation of Data-

- ❖ The data we collect can often be more easily understood for interpretation if it is presented graphically or pictorially.
- ❖ Diagrams and graphs give visual indications of magnitudes, groupings, trends and patterns in the data.
- ❖ These important features are more simply presented in the form of graphs. Also, diagrams facilitate comparisons between two or more sets of data.
- ❖ The diagrams should be clear and easy to read and understand.
- ❖ Too much information should not be represented through the same diagram; otherwise, it may become cumbersome and confusing.
- ❖ Each diagram should include a brief and self explanatory title dealing with the subject matter.
- ❖ The scale of the presentation should be chosen in such a way that the resulting diagram is of appropriate size.

- ❖ The intervals on the vertical as well as the horizontal axis should be of equal size; otherwise, distortions would occur.
- ❖ Diagrams are more suitable to illustrate discrete data, while continuous data is better represented by graphs.
- ❖ Graphical Representation is a way of analysing numerical data.
- ❖ It exhibits the relation between data, ideas, information and concepts in a diagram.
- ❖ It is easy to understand and it is one of the most important learning strategies.
- ❖ It always depends on the type of information in a particular domain.
- ❖ There are different types of graphical representation.

General Rules for Graphical Representation of Data

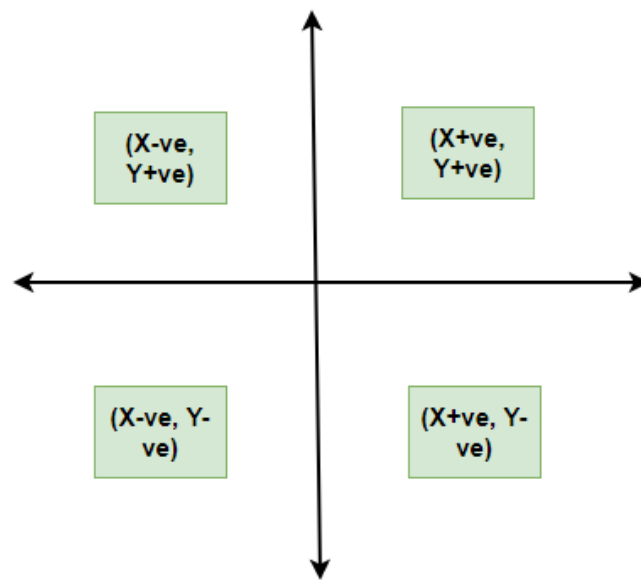
There are certain rules to effectively present the information in the graphical representation. They are:

- **Suitable Title:** Make sure that the appropriate title is given to the graph which indicates the subject of the presentation.
- **Measurement Unit:** Mention the measurement unit in the graph.
- **Proper Scale:** To represent the data in an accurate manner, choose a proper scale.
- **Index:** Index the appropriate colours, shades, lines and design in the graphs for better understanding.
- **Data Sources:** Include the source of information wherever it is necessary at the bottom of the graph.
- **Keep it Simple:** Construct a graph in an easy way that everyone can understand.
- **Neat:** Choose the correct size, fonts, colours etc. in such a way that the graph should be a visual aid for the presentation of information.

Principles of Graphical Representations

All types of graphical representations require some rule/principles which are to be followed. These are some algebraic principles. When we plot a graph, there is an origin, and we have

our two axes. These two axes divide the plane into four parts called quadrants. The horizontal one is usually called the x-axis and the other one is called the y-axis. The origin is the point where these two axes intersect. The thing we need to keep in mind about the values of the variable on the x-axis is that positive values need to be on the right side of the origin and negative values should be on the left side of the origin. Similarly, for the variable on the y-axis, we need to make sure that the positive values of this variable should be above the x-axis and negative values of this variable must be below the y-axis.



Advantages and Disadvantages of using Graphical System

Advantages:

1. It gives us a summary of the data which is easier to look at and analyze.
2. We can compare and study more than one variable at a time.
3. The graph presents data in a manner which is easier to understand.
4. It allows us to present statistical data in an attractive manner as compared to tables. Users can understand the main features, trends, and fluctuations of the data at a glance.
5. A graph saves time.
6. It allows the viewer to compare data relating to two different time-periods or regions.
7. The viewer does not require prior knowledge of mathematics or statistics to understand a graph.
8. We can use a graph to locate the mode, median, and mean values of the data.
9. It is useful in forecasting, interpolation, and extrapolation of data.

Disadvantage:

1. It usually takes only one aspect of the data and ignores the other. For example, a bar graph does not represent the mean, median, and other statistics of the data.
2. A graph lacks complete accuracy of facts.
3. It depicts only a few selected characteristics of the data.
4. We cannot use a graph in support of a statement.
5. A graph is not a substitute for tables.
6. Usually, laymen find it difficult to understand and interpret a graph.
7. Typically, a graph shows the unreasonable tendency of the data and the actual values are not clear.

Types of Graphical Representations-

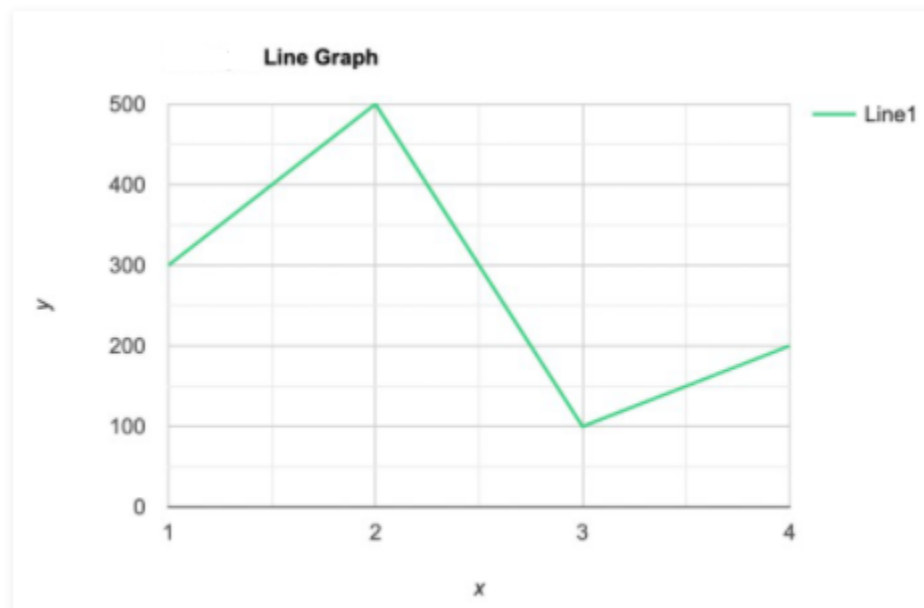
Comparison between different items is best shown with graphs; it becomes easier to compare the crux out of the data pertaining to different items. There are different types of graphical representations-

- ❖ Line Graphs
- ❖ Bar Graphs
- ❖ Histograms
- ❖ Circle or Pie Chart
- ❖ Cumulative Frequency Curve
- ❖ Frequency Polygon

Line Graphs-

- ✚ Line graphs are used to represent quantitative data collected over a specific subject and a specific time interval.
- ✚ All the data points are connected by a line.
- ✚ Data points represent the observations that are collected on a survey or research.
- ✚ Line graphs are also called line charts or Line plot.
- ✚ The line graph has an x-axis and a y-axis.
- ✚ The world today is becoming more and more information-oriented.
- ✚ Every part of our lives utilizes data in one form or another.

- ✚ The tabular representation of data is an ideal way of presenting them systematically.
- ✚ When these numerical figures are represented graphically in the form of a bar graph or a line graph, they become more noticeable and easily understandable, leaving a long-lasting effect on the mind of the observer.
- ✚ On this page, we will learn about line graphs, their sections, how to read and create graphs and solve interesting problems around them.
- ✚ Line graphs have a horizontal axis called the **x-axis** and a vertical axis called the **y-axis**.
- ✚ The x-axis usually has a time period over which we would like to measure the quantity of a specific thing or an item in the y-axis.
- ✚ Line graphs help to analyze the trend of whether the quantity in the y-axis is increasing or decreasing over a period of time.
- ✚ Line graphs give a clear picture of an increasing or a decreasing trend.



Types of Line Graphs

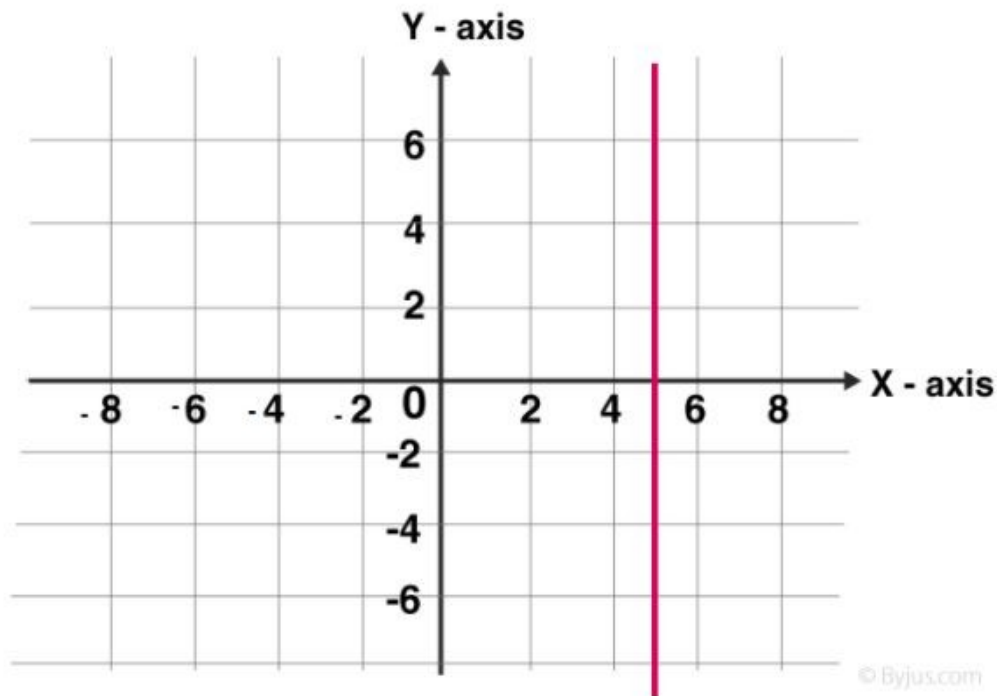
The following are the types of the line graph. They are:

1. **Simple Line Graph:** Only one line is plotted on the graph.

2. **Multiple Line Graph:** More than one line is plotted on the same set of axes. A multiple line graph can effectively compare similar items over the same period of time.
3. **Compound Line Graph:** If information can be subdivided into two or more types of data. This type of line graph is called a compound line graph. Lines are drawn to show the component part of a total. The top line shows the total and line below shows part of the total. The distance between every two lines shows the size of each part.

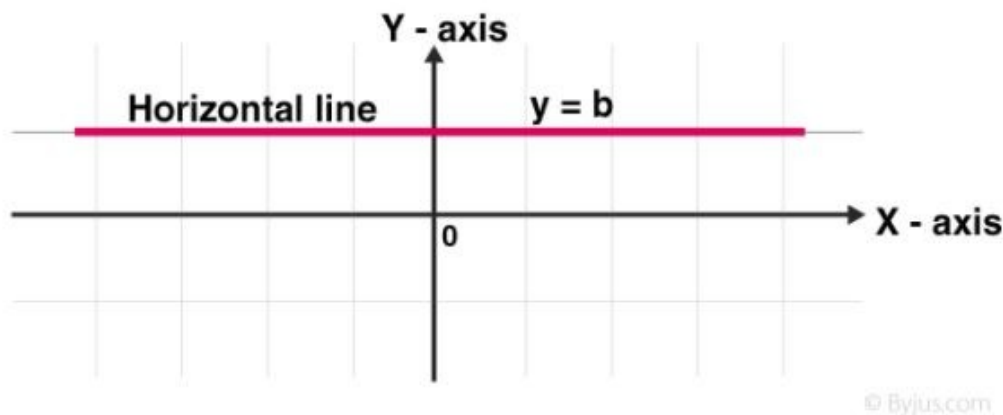
Vertical Line Graph

Vertical line graphs are graphs in which a vertical line extends from each data point down to the horizontal axis. Vertical line graph sometimes also called a column graph. A line parallel to the y-axis is called a vertical line.



Horizontal Line Graph

Horizontal line graphs are graphs in which a horizontal line extends from each data point parallel to the x-axis. Horizontal line graph sometimes also called a row graph. A line parallel to the x-axis is called a horizontal line.



Straight Line Graph

A line graph is a graph formed by segments of straight lines that join the plotted points that represent given data. The line graph is used to solve changing conditions, often over a certain time interval. A general linear function has the form $y = mx + c$, where m and c are constants.

The fundamental rule at the rear of sketching a linear graph is that we require only two points to graph a straight line. The subsequent procedure is followed in drawing linear graphs:

- By substituting two dissimilar values for x in the equation $y = mx + c$, we get two values for y . Thus, we get two points (x_1, y_1) and (x_2, y_2) on the line.
- Plot the horizontal line and vertical line and select the suitable scale for both the axes.
- If the given table values are large choose the scale for that particular value. It depends on the given value.
- Plot the two points in the Cartesian plane of the paper. Join the two points using a line segment and extend to two directions. The closed figure obtained is the required linear graph.

Different Parts of Line Graph

Title: The title explains what graph is to be plotted.

Scale: The scale is the numbers that explain the units utilized on the linear graph.

Labels: Both the side and the bottom of the linear graph have a label that indicates what kind of data is represented in the graph. X-axis describes the data points on the line and the y-axis shows the numeric value for each point on the line.

Bars: They measure the data number.

Data values: they are the actual numbers for each data point.

Double Line Graph

A double line graph is a line graph with two lines. A graph that compares two different subjects over a period of time. A double line graph shows how things change over a period of time. The double line graph shows two line graphs within one chart. Double line graphs are used to compare trends and patterns between two subjects.

Steps to Make a Double Line Graph:

- Use the data from the table to choose an appropriate scale.
- Draw and label the scale on the vertical and horizontal axis.
- List each item and locate the points on the graph for both the lines.
- Connect the points with line segments separately of both the lines.
- Draw two line graphs within one chart.

Uses of Line Graph

- ❖ The important use of line graph is to track the changes over the short and long period of time.
- ❖ It is also used to compare the changes over the same period of time for different groups.
- ❖ It is always better to use the line than the bar graph, whenever the small changes exist. For example, in company finance team wants to plot the changes in the cash amount that the company has on hand over time. In that case, they use the line graph plotting the points over the horizontal and the vertical axis.
- ❖ It usually represents the time period of the data.

Advantages-

- It is beneficial for showing changes and trends over different time periods.
- It is also helpful to show small changes that are difficult to measure in other graphs.
- Line graphs are common and effective charts because they are simple, easy to understand, and efficient.
- It is useful to highlight anomalies within and across data series. More than one line may be plotted on the same axis as a form of comparison.

Disadvantages-

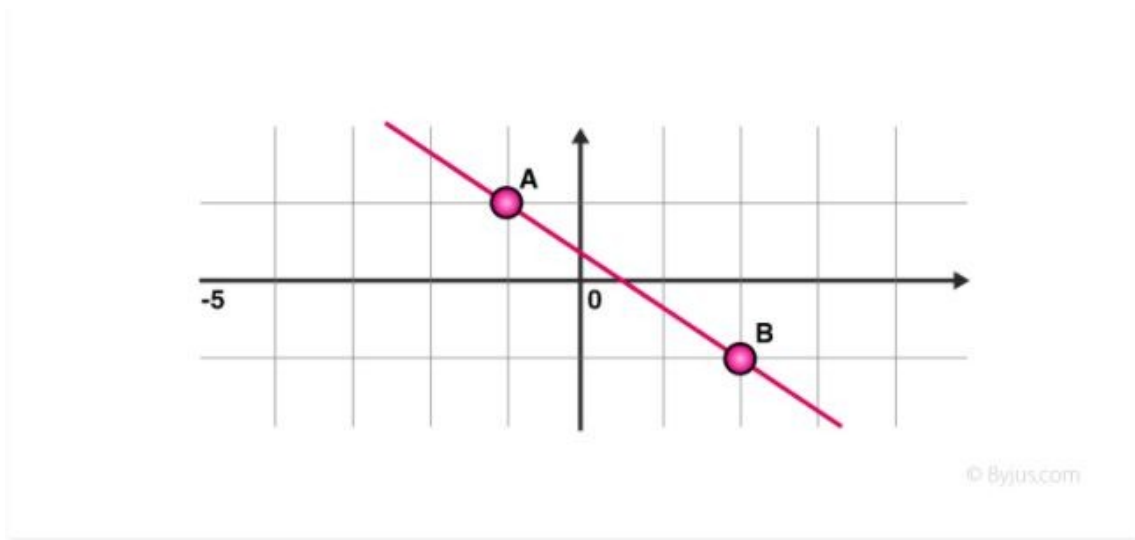
- Plotting too many lines over the graph makes it cluttered and confusing to read.
- A wide range of data is challenging to plot over a line graph.
- They are only ideal for representing data that have numerical values and total figures such as values of total rainfall in a month.
- If consistent scales on the axis aren't used, it might lead to the data of a line graph appearing inaccurate.
- Also, line graphs are inconvenient if you have to plot fractions or decimal numbers.

How to Make a Line Graph?

If we have created data tables, then we draw linear graphs using the data tables. These graphs are plotted as a series of points, which are later joined with straight lines to provide a simple way to review data collected over time. It offers an excellent visual format of the outcome data collected over time.

To plot a linear/line graph follow the below steps:

1. Use the data from the data-table to choose a suitable scale.
2. Draw and label the scale on the vertical (y-axis) and horizontal (x-axis) axes.
3. List each item and place the points on the graph.
4. Join the points with line segments.

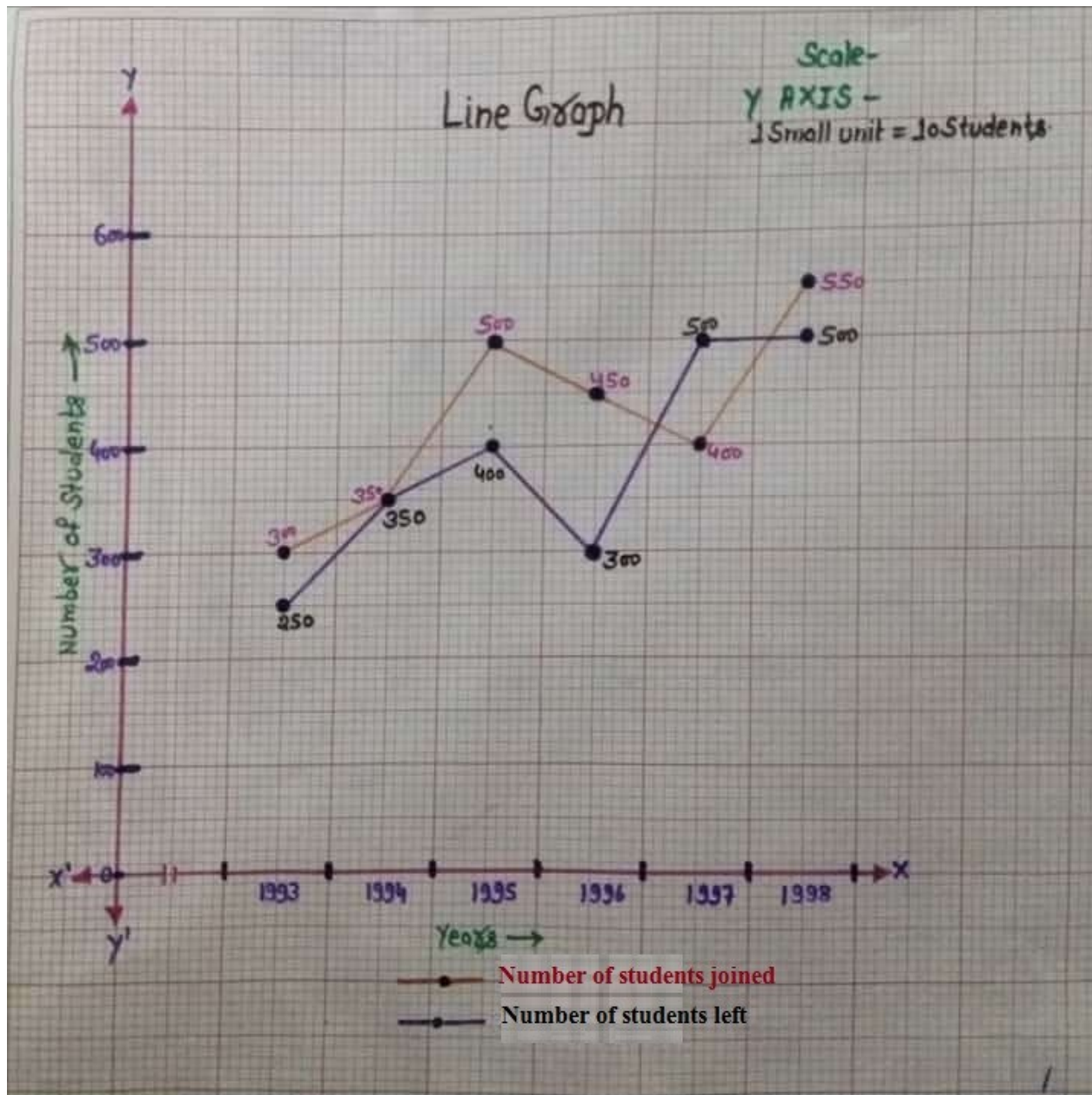


Example:

The following table shows the number of students who joined and left the school after in the beginning of year for six years, from 1993 to 1998. Draw the Line Graph of the following data-

| Years | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|---------------------------|------|------|------|------|------|------|
| Number of students joined | 300 | 350 | 500 | 450 | 400 | 550 |
| Number of students left | 250 | 350 | 400 | 300 | 500 | 500 |

Answer-



Construction of Line Graph through MS Excel-

Although Excel provides several layout and formatting presets to enhance the look and readability of the chart, below are the top five best practices to make the chart or graph as clear and useful as possible-

1. Make It Clean: Cluttered graphs-those with excessive colors or texts can be difficult to read and aren't eyes catching. Remove any unnecessary information so the audience can focus on the point that trying to get across.

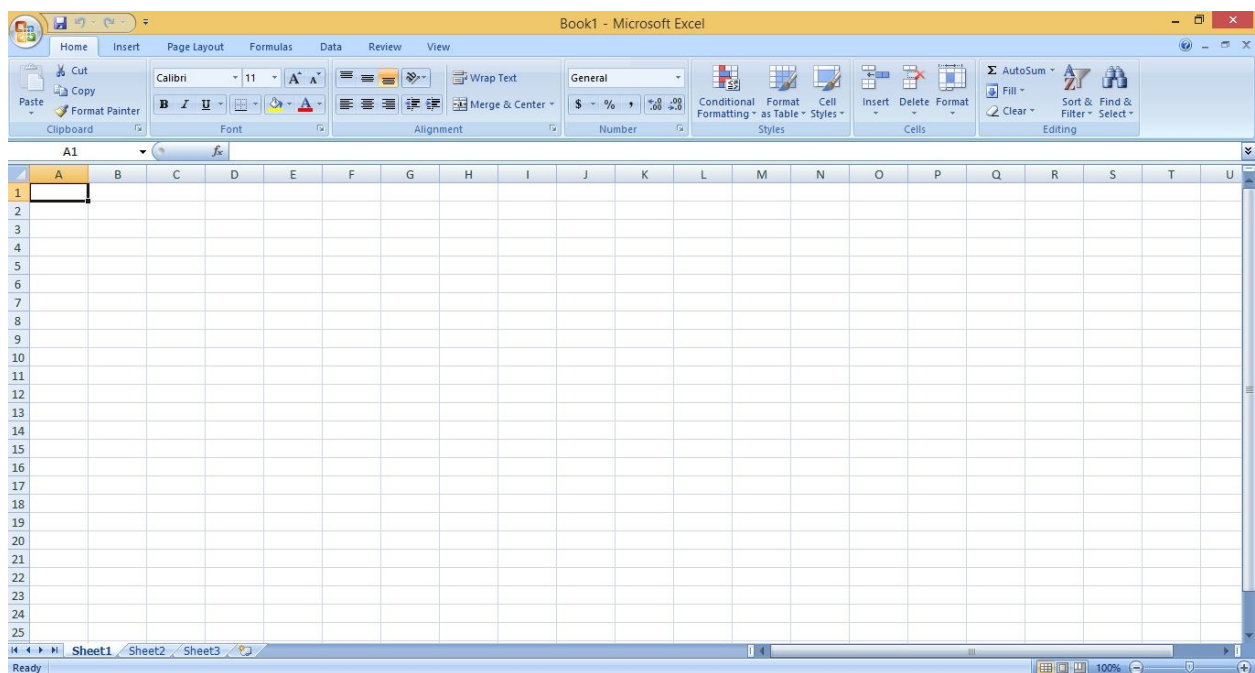
2. Choose Appropriate Themes: Consider the audience, the topic, and the main point of the chart when selecting a theme. While it can be fun to experiment with different styles, choose the theme that best fits on purpose.

3. Use Text Wisely: While charts and graphs are primarily visual tools, some text will likely include (such as titles or axis labels). Be concise but use descriptive language, and be intentional about the orientation of any text (for example, it's irritating to turn the head to read text written sideways on the x-axis).

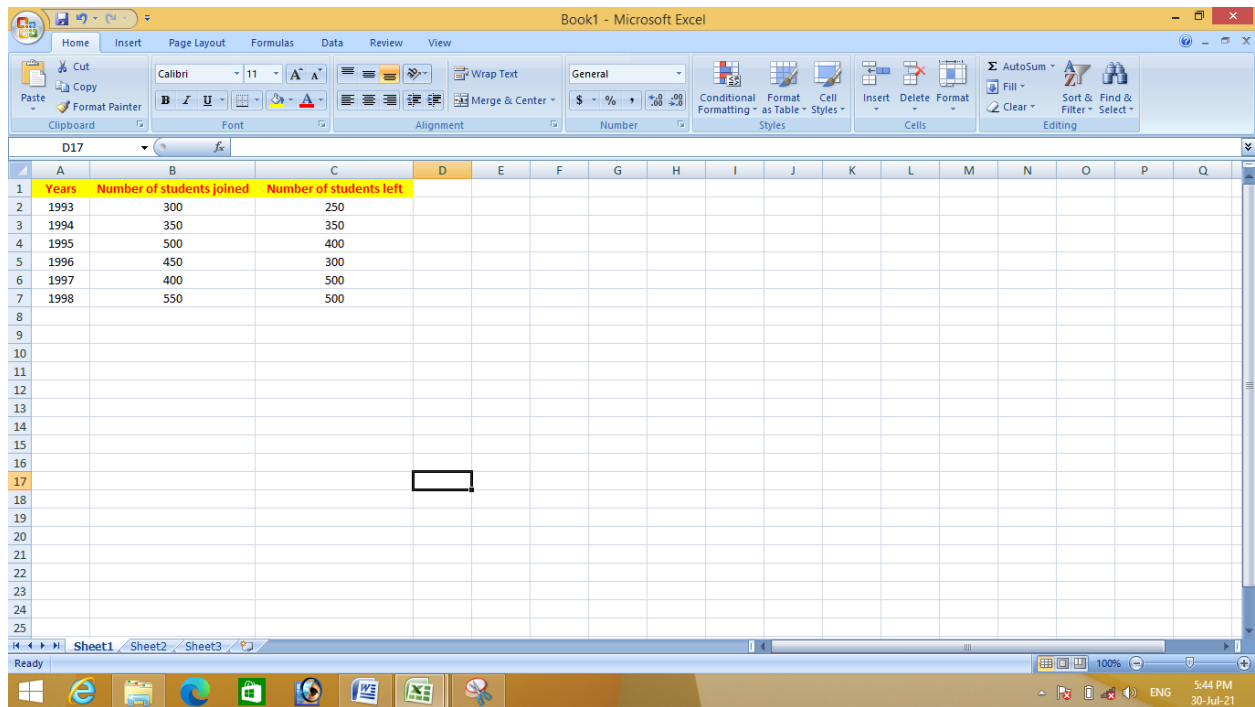
4. Place Elements Intelligently: Pay attention to where place titles, legends, symbols, and any other graphical elements. They should enhance the chart, not detract from it.

5. Sort Data Prior to Creating the Chart: People often forget to sort data or remove duplicates before creating the chart, which makes the visual unintuitive and can result in errors.

Step 1- Open 'MS Excel' and select 'New Workbook'.

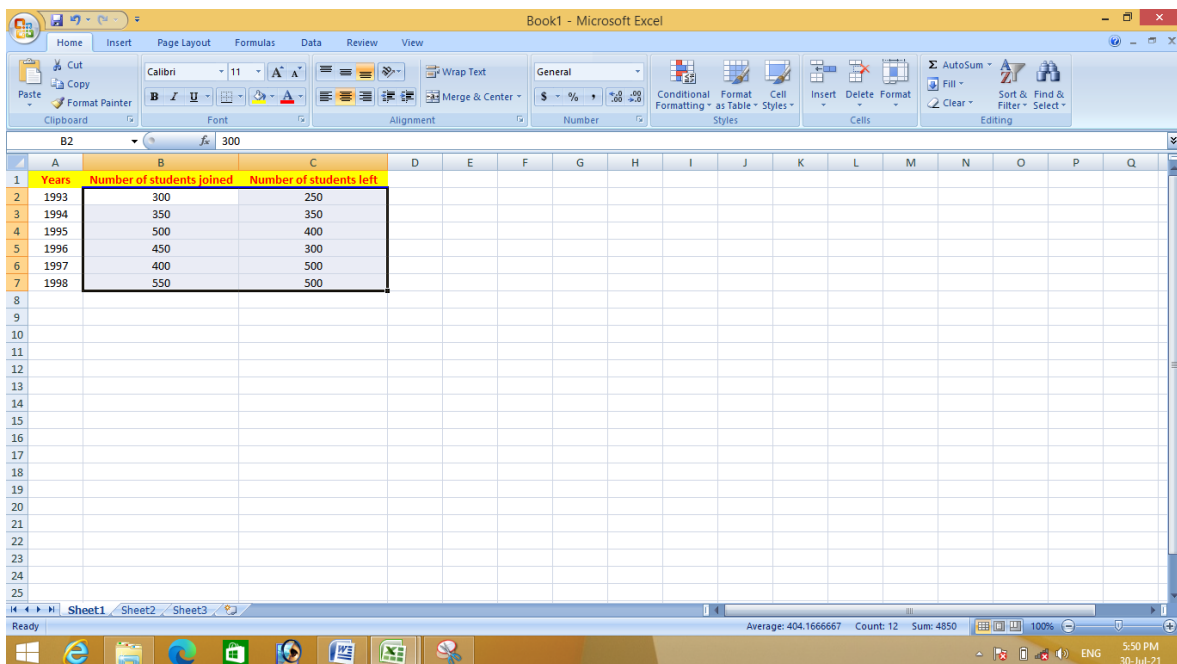


Step 2- Enter the data labels for columns and rows.



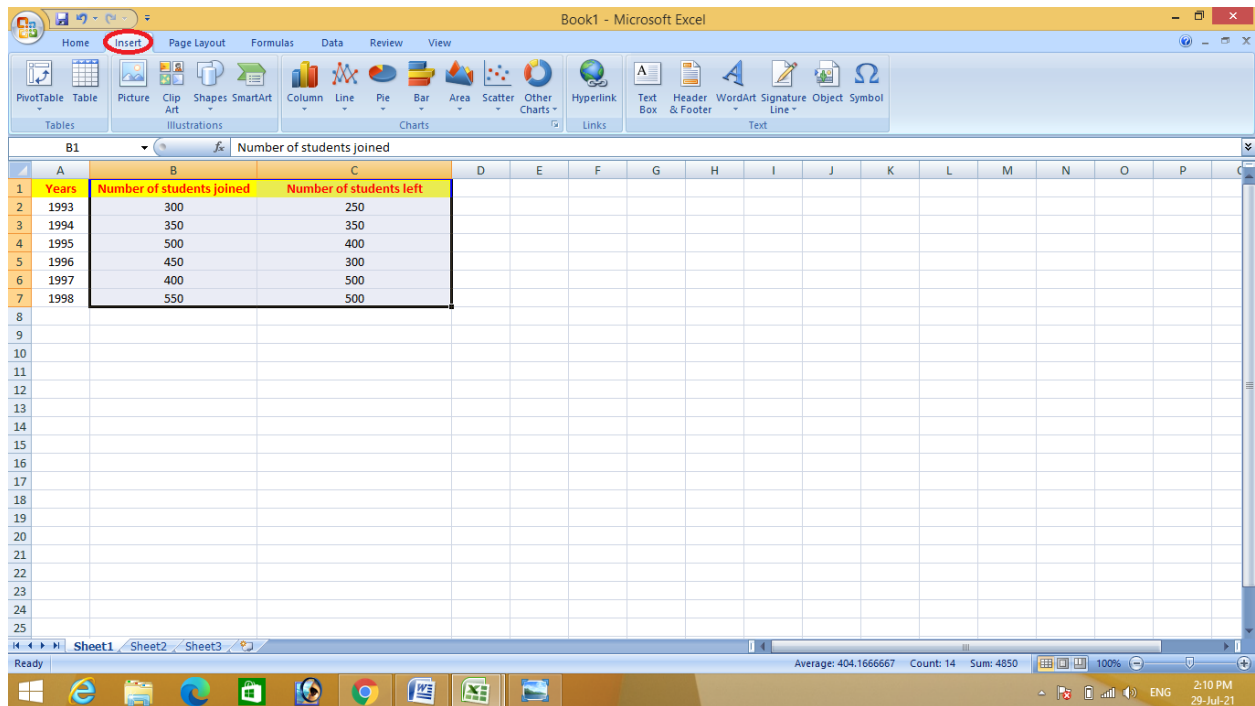
Step 3- Select Range

- I. Highlight the cells that contain the data by clicking and dragging mouse across the cells.
- II. The cell range will now be highlighted in gray and a chart type can be selected.

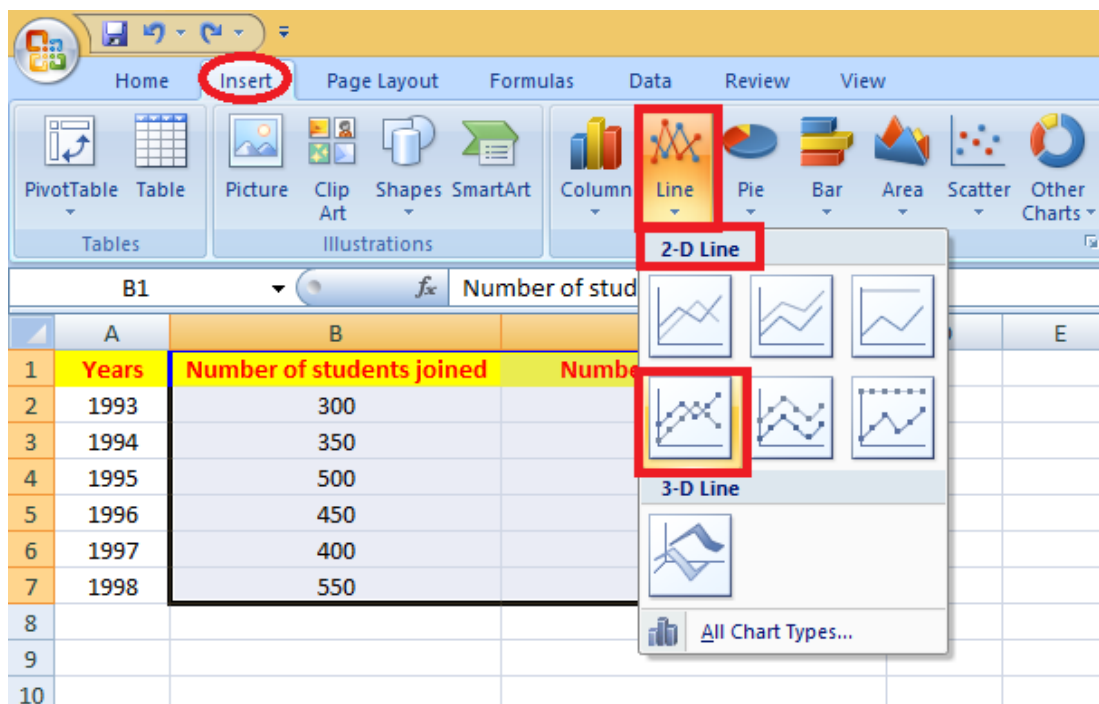


Step 4- Select Chart type

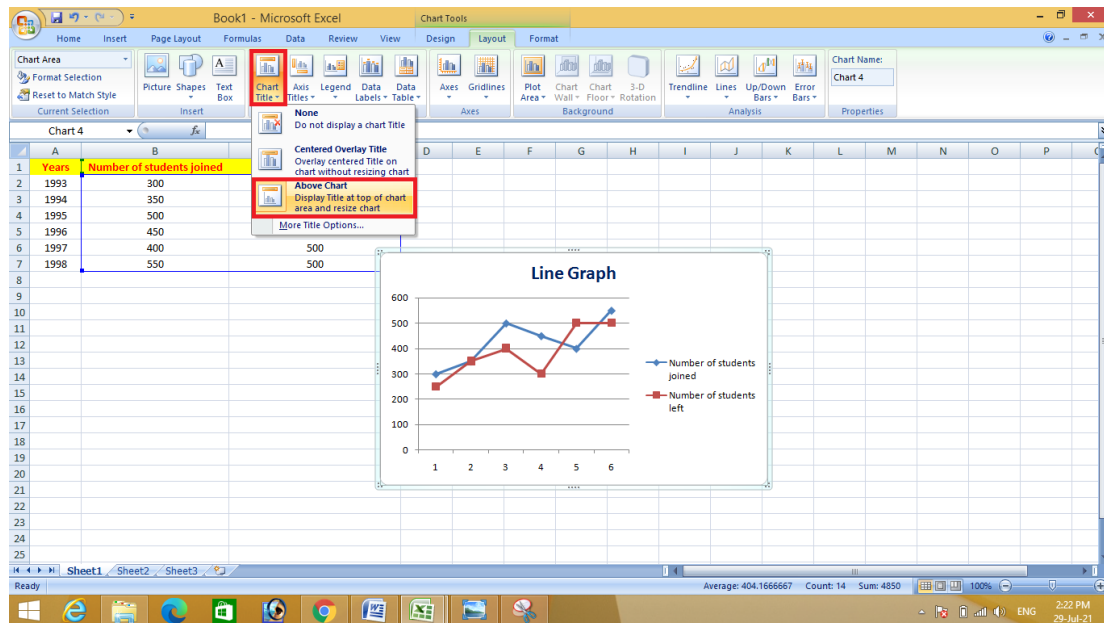
- Click the 'Insert' tab on the top banner. About halfway across the toolbar is a section with several chart options. Excel provides different charts that can be selected by clicking any of the dropdown menus.



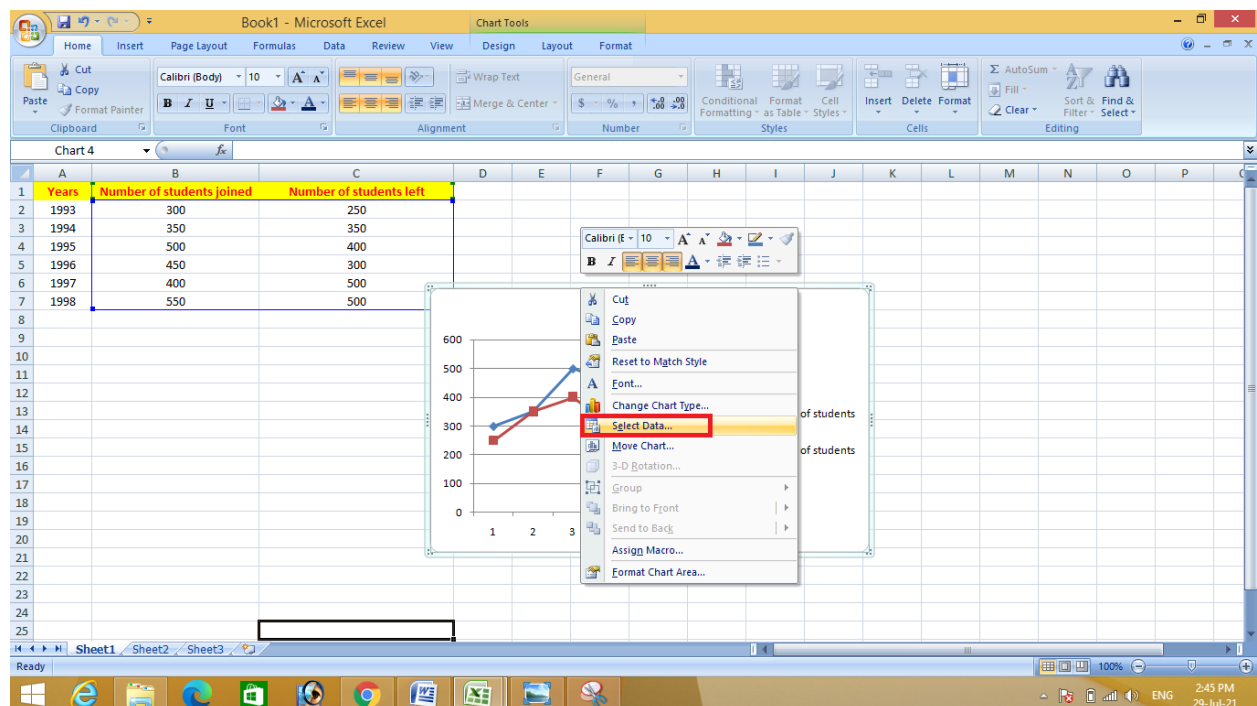
Step 5- Click the 'Line Chart' icon and select '2-D Line.'



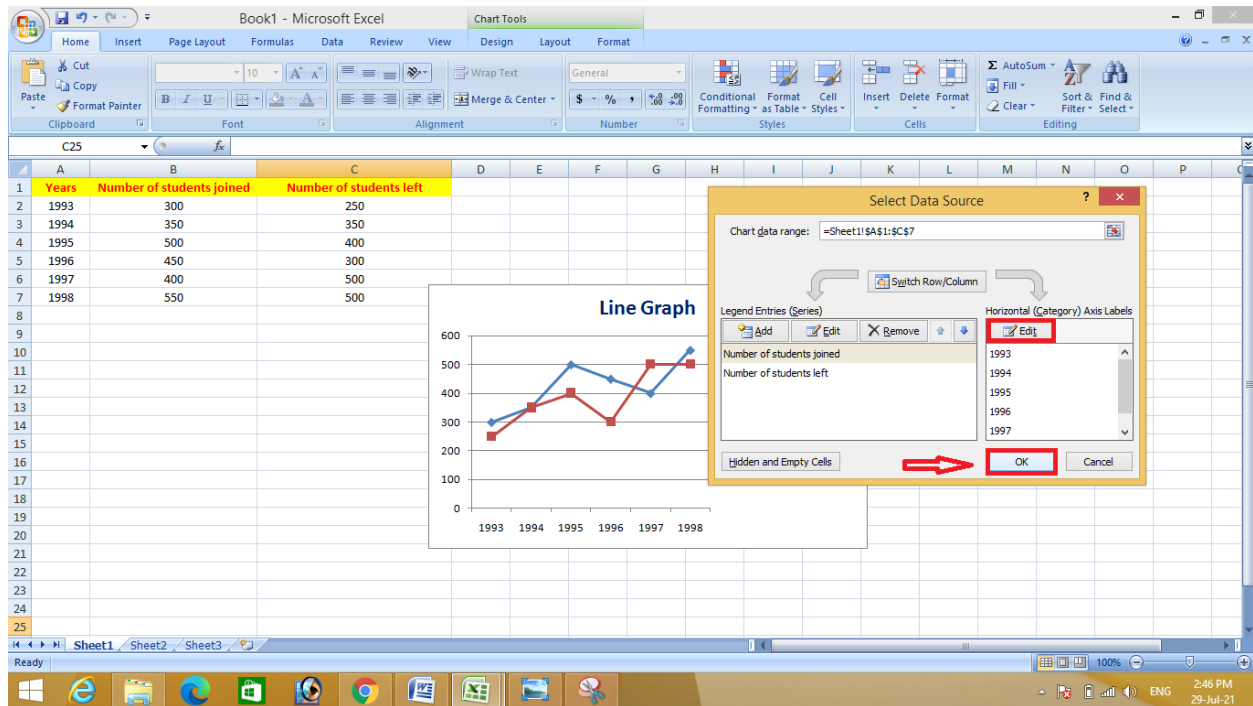
- Excel will automatically create a '2-D Line Chart' from the selected data. The chart will appear in the centre of the workbook.
- To name the chart, click on 'Layout' tab and choose the option 'Chart Title' and select the 'Above Chart' from the dropdown menu.



Step 6- Right click the mouse on the inserted graph and choose the option 'Select Data'.



- Click on 'Edit' to fill the horizontal axis data.

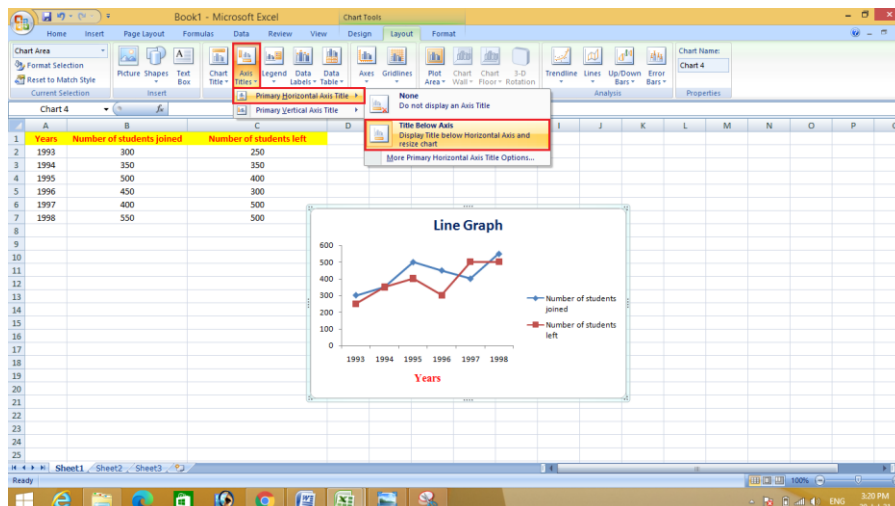


Step 7- Add Chart Elements

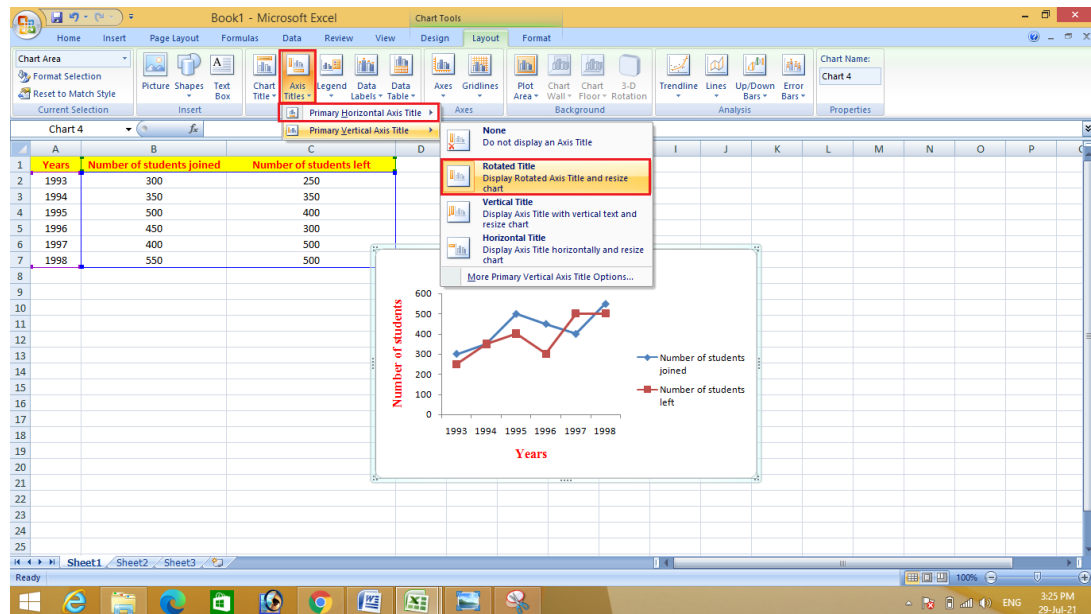
Adding chart elements to the chart or graph will enhance it by clarifying data or providing additional context.

❖ To Add Axis Title:

- To create horizontal axis title, click on 'Layout' tab and choose the option 'Axis Title.' Select the 'Primary Horizontal Axis Title' and 'Title Below Axis' respectively from the dropdown menu. A text box will appear on the chart.

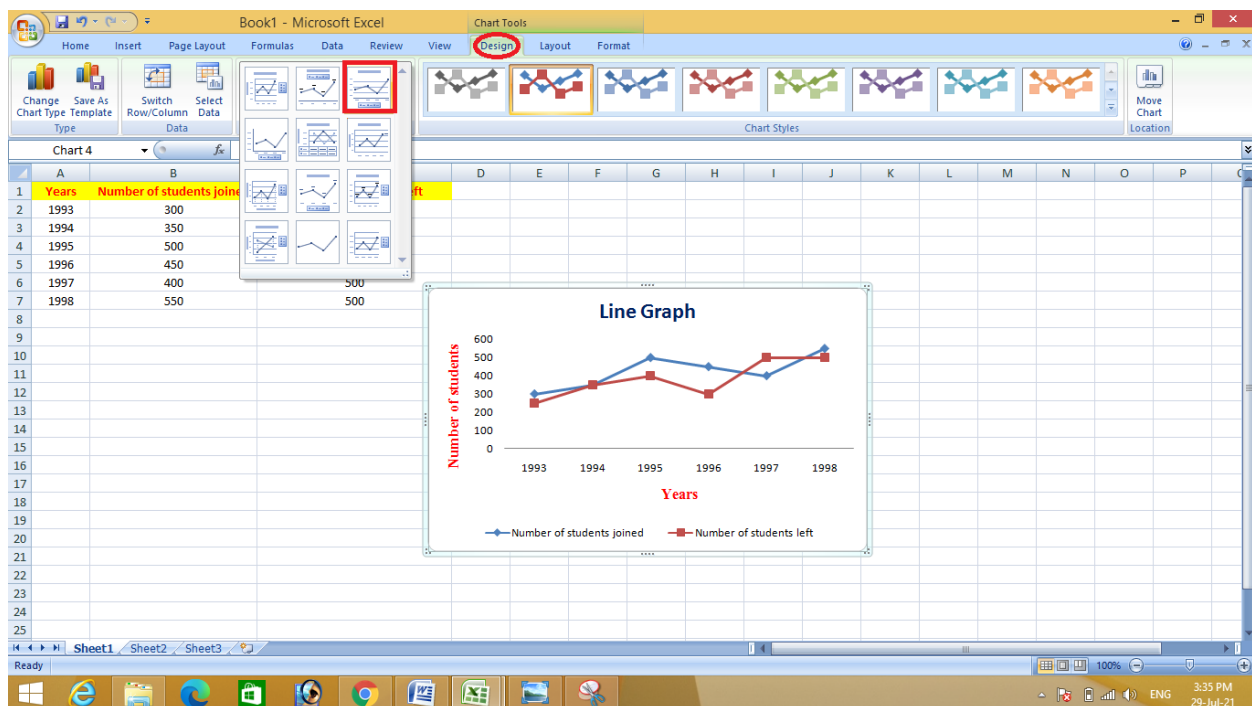


- II. To create vertical axis title, click on 'Layout' tab and choose the option 'Axis Title.' Select the 'Primary Vertical Axis Title' and 'Rotated Title' respectively from the dropdown menu. A text box will appear on the chart.



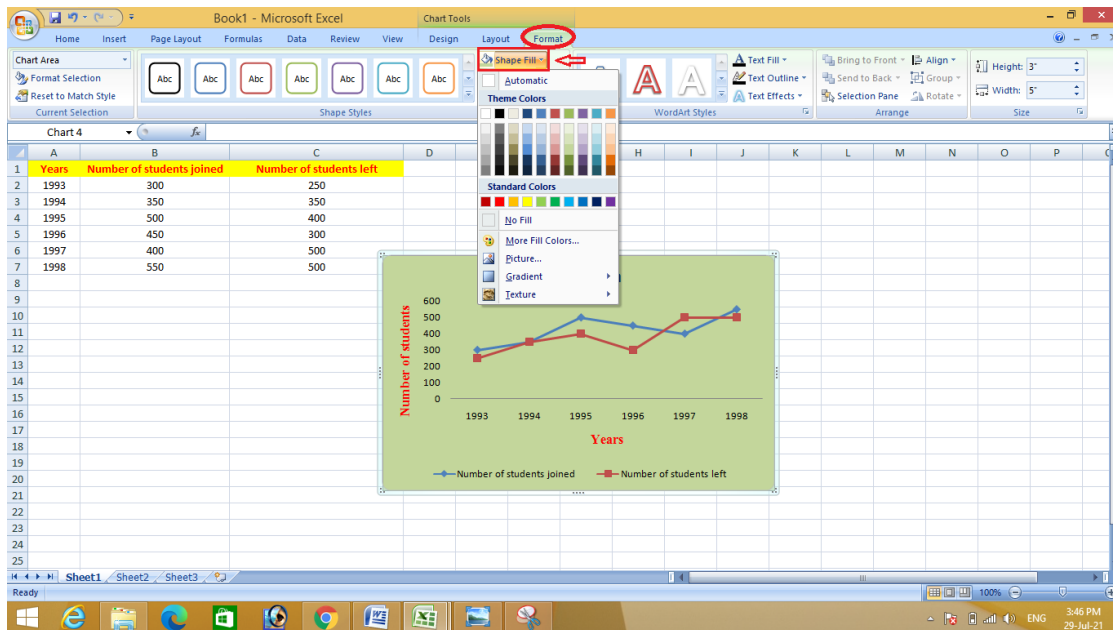
Step 8- Adjust Quick Layout

Click on 'Design' tab to select different layout of graph from the dropdown menu.



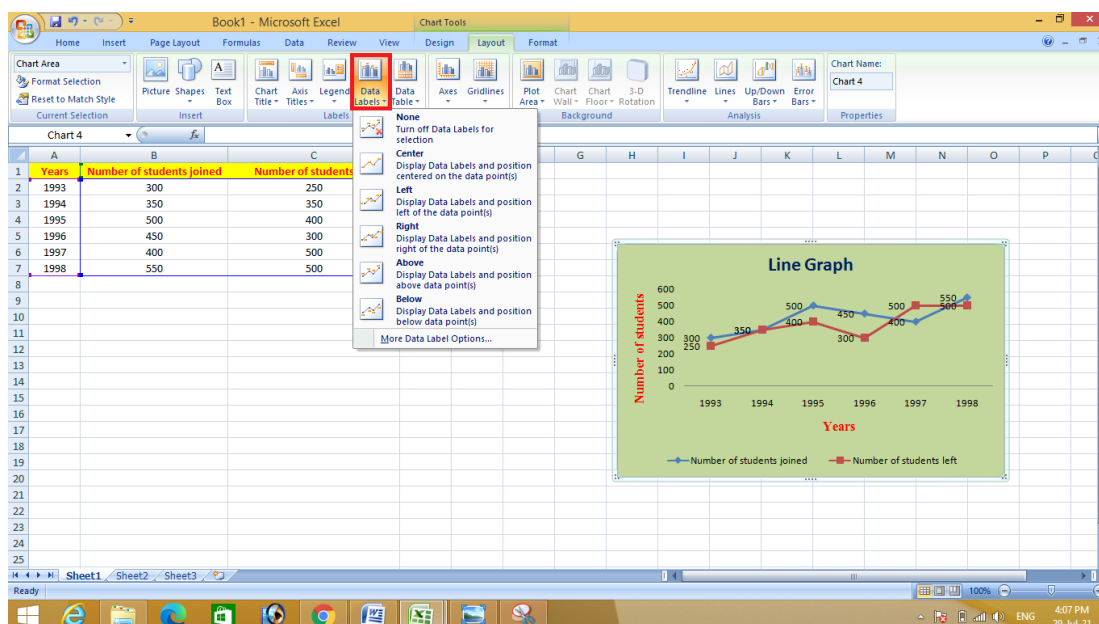
Step 9- Change Formatting

The 'Format' tab allows to change formatting of all elements and text in the chart, including colors, size, shape fill and alignment. Click on 'Format' tab and choose 'Shape Fill' option to format the chart.

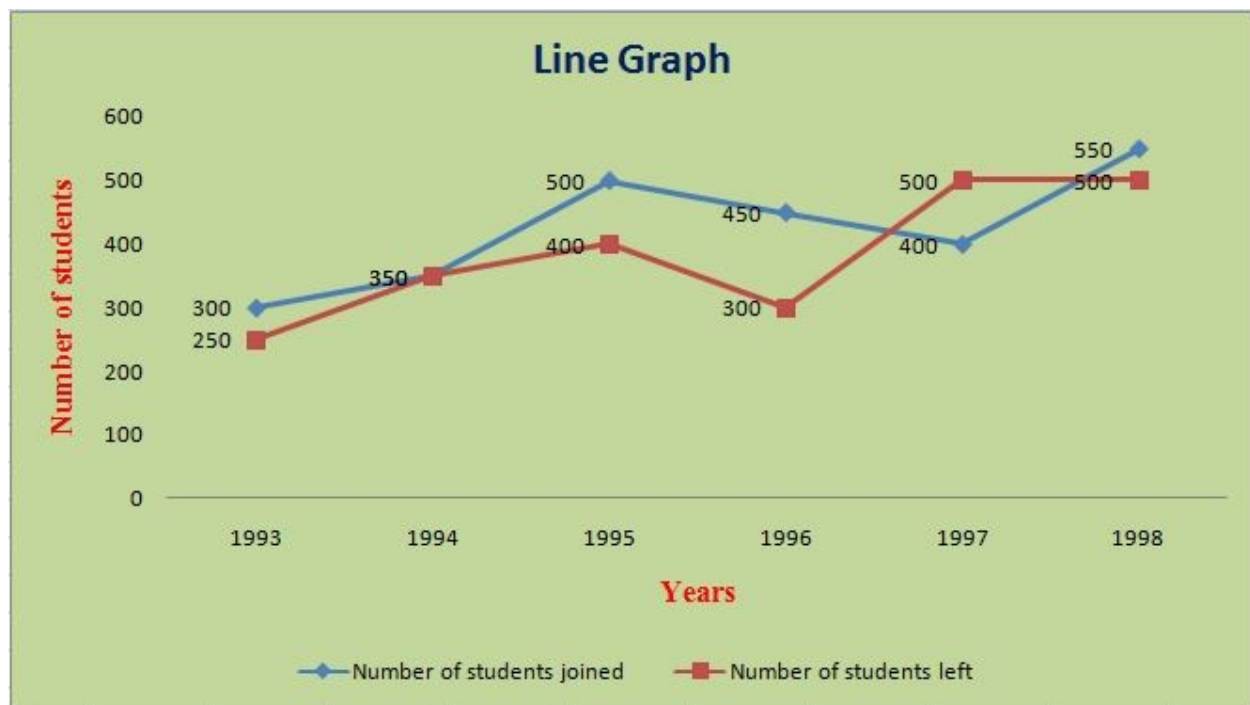


Step 10- To Add Data Labels:

Click on 'Layout' tab and click on 'Data Label.' There are seven options for data labels: None (default), Centre, Left, Right, Above, Below, and More Data label Title Options. Select anyone of them according to choice.

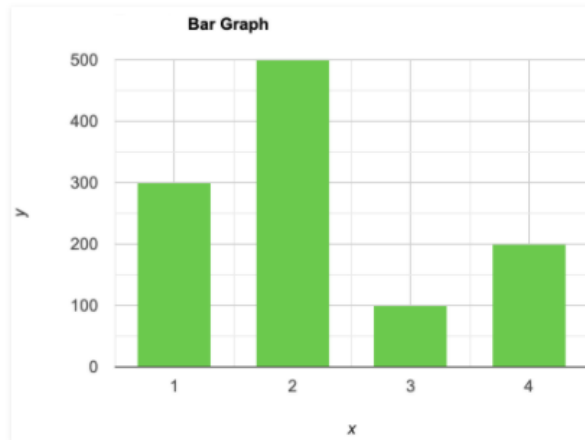


Step 11- Final 'Line Chart'.



Bar Graphs-

- ❖ The pictorial representations of a grouped data, in the form of vertical or horizontal rectangular bars, where the lengths of the bars are equivalent to the measure of data, are known as bar graphs or bar charts.
- ❖ The bars drawn are of uniform width, and the variable quantity is represented on one of the axes. Also, the measure of the variable is depicted on the other axes.
- ❖ The heights or the lengths of the bars denote the value of the variable, and these graphs are also used to compare certain quantities.
- ❖ The frequency distribution tables can be easily represented using bar charts which simplify the calculations and understanding of data.



The three major attributes of bar graphs are:-

- The bar graph helps to compare the different sets of data among different groups easily.
- It shows the relationship using two axes, in which the categories on one axis and the discrete values on the other axis.
- The graph shows the major changes in data over time.

Types of Bar Charts

The bar graphs can be vertical or horizontal. The primary feature of any bar graph is its length or height. If the length of the bar graph is more, then the values are greater than any given data.

Bar graphs normally show categorical and numeric variables arranged in class intervals. They consist of an axis and a series of labeled horizontal or vertical bars. The bars represent frequencies of distinctive values of a variable or commonly the distinct values themselves. The number of values on the x-axis of a bar graph or the y-axis of a column graph is called the scale.

The types of bar charts are as follows:

1. Vertical bar chart
2. Horizontal bar chart

Even though the graph can be plotted using horizontally or vertically, the most usual type of bar graph used is the vertical bar graph. The orientation of the **x-axis** and **y-axis** are changed

depending on the type of vertical and horizontal bar chart. Apart from the vertical and horizontal bar graph, the two different types of bar charts are:

3. Grouped Bar Graph
4. Stacked Bar Graph

Vertical Bar Graphs

When the grouped data are represented vertically in a graph or chart with the help of bars, where the bars denote the measure of data, such graphs are called vertical bar graphs. The data is represented along the y-axis of the graph, and the height of the bars shows the values.

Horizontal Bar Graphs

When the grouped data are represented horizontally in a chart with the help of bars, then such graphs are called horizontal bar graphs, where the bars show the measure of data. The data is depicted here along the x-axis of the graph, and the length of the bars denotes the values.

Grouped Bar Graph

The grouped bar graph is also called the clustered bar graph, which is used to represent the discrete value for more than one object that shares the same category. In this type of bar chart, the total number of instances is combined into a single bar. In other words, a grouped bar graph is a type of bar graph in which different sets of data items are compared. Here, a single colour is used to represent the specific series across the set. The grouped bar graph can be represented using both vertical and horizontal bar charts.

Stacked Bar Graph

The stacked bar graph is also called the composite bar chart, which divides the aggregate into different parts. In this type of bar graph, each part can be represented using different colours, which helps to easily identify the different categories. The stacked bar chart requires specific labeling to show the different parts of the bar. In a stacked bar graph, each bar represents the whole and each segment represents the different parts of the whole.

Properties of Bar Graph

Some of the important properties of a bar graph are as follows:

- All the bars should have a common base.





- Each column in the bar graph should have equal width.
- The height of the bar should correspond to the data value.
- The distance between each bar should be the same.

Uses of Bar Graphs



Bar graphs are used to match things between different groups or to trace changes over time. Yet, when trying to estimate change over time, bar graphs are most suitable when the changes are bigger.

Bar charts possess a discrete domain of divisions and are normally scaled so that all the data can fit on the graph. When there is no regular order of the divisions being matched, bars on the chart may be organized in any order. Bar charts organized from the highest to the lowest number are called Pareto charts.

Advantages:

-  Bar graph summarizes the large set of data in simple visual form.
-  It displays each category of data in the frequency distribution.
-  It clarifies the trend of data better than the table.
-  It helps in estimating the key values at a glance.

Disadvantages:

-  Sometimes, the bar graph fails to reveal the patterns, cause, effects etc.
-  It can be easily manipulated to yield fake information.

How to Draw a Bar Graph?

Let us consider an example, we have four different types of pets, such as cat, dog, rabbit, and hamster and the corresponding numbers are 22, 39, 5 and 9 respectively.

In order to visually represent the data using the bar graph, we need to follow the steps given below.

Step 1: First, decide the title of the bar graph.

Step 2: Draw the horizontal axis and vertical axis. (For example, Types of Pets)

Step 3: Now, label the horizontal axis.

Step 4: Write the names on the horizontal axis, such as Cat, Dog, Rabbit, and Hamster.

Step 5: Now, label the vertical axis. (For example, Number of Pets)

Step 6: Finalize the scale range for the given data.

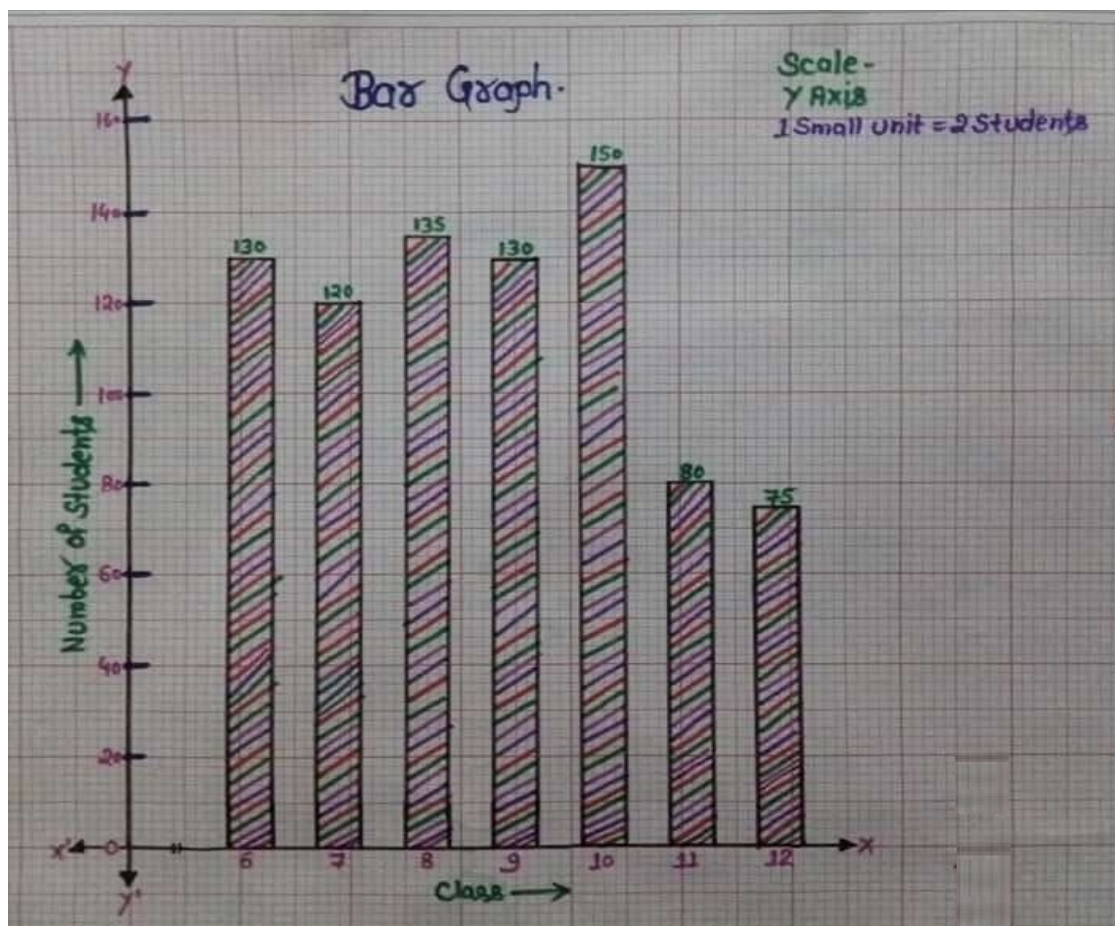
Step 7: Finally, draw the bar graph that should represent each category of the pet with their respective numbers.

Example:

The number of students in 7 different classes is given below. Represent this data on the bar graph.

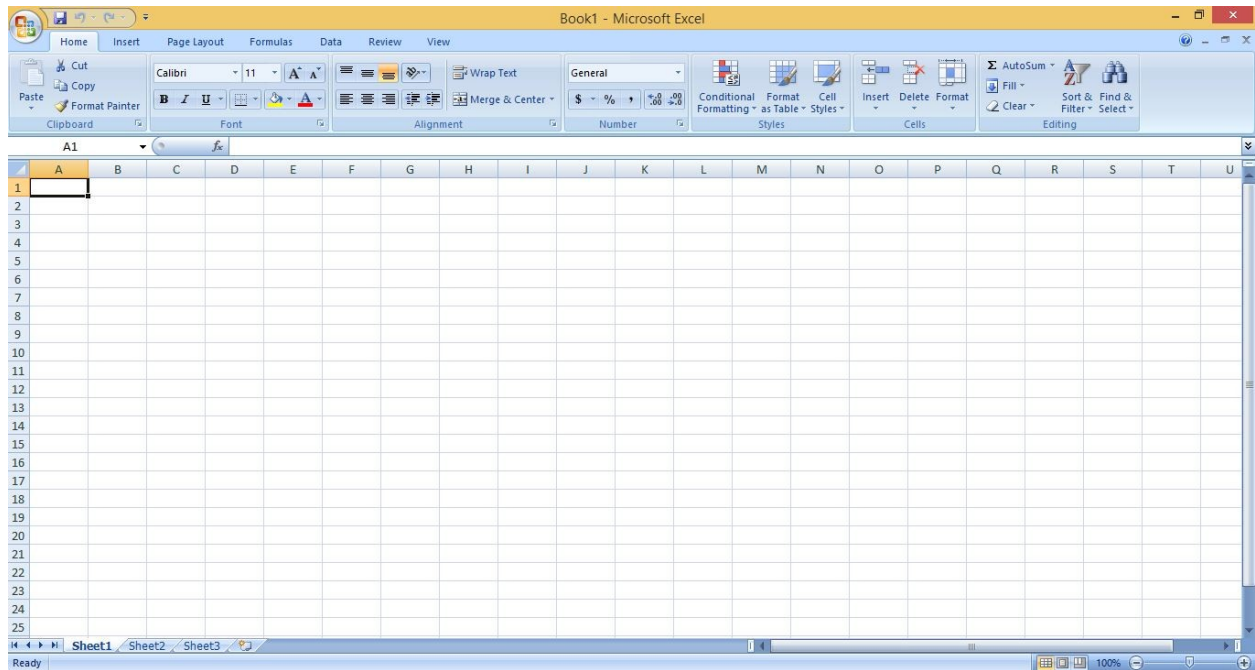
| Class | 6 th | 7 th | 8 th | 9 th | 10 th | 11 th | 12 th |
|--------------------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|------------------|
| Number of Students | 130 | 120 | 135 | 130 | 150 | 80 | 75 |

Answer-

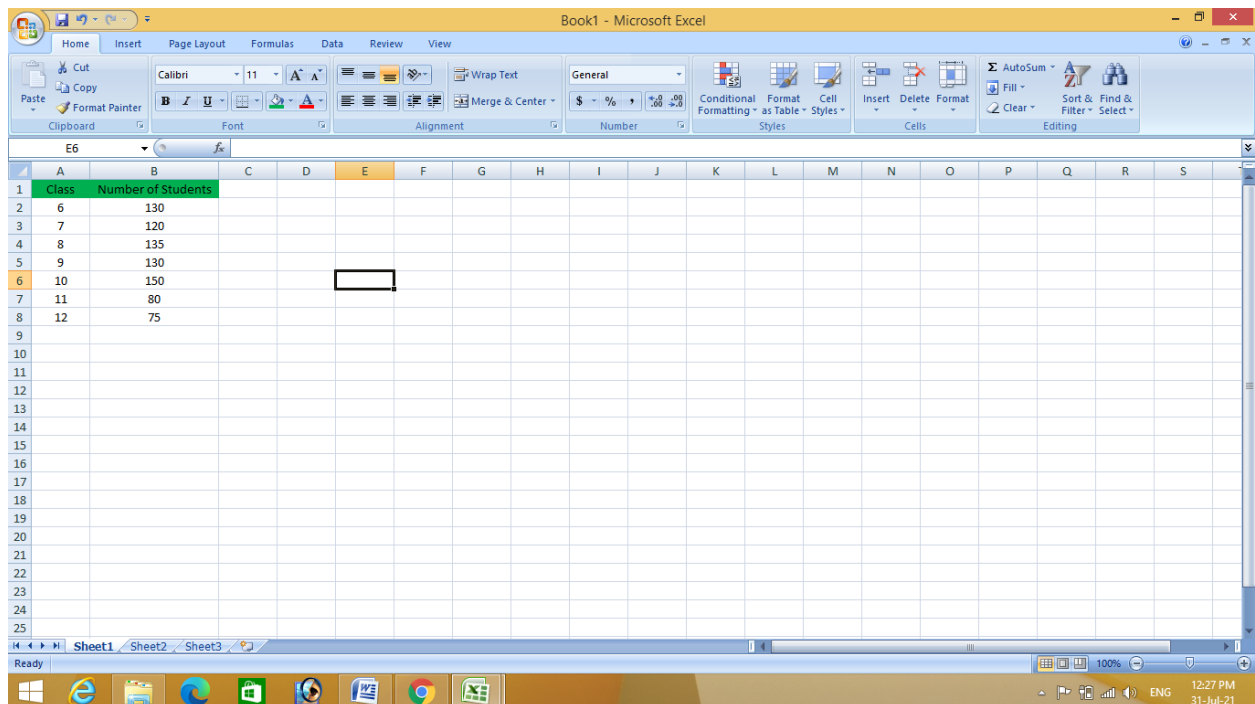


Construction of 'Bar Graph' through MS Excel-

Step 1- Open 'MS Excel' and select 'New Workbook'.

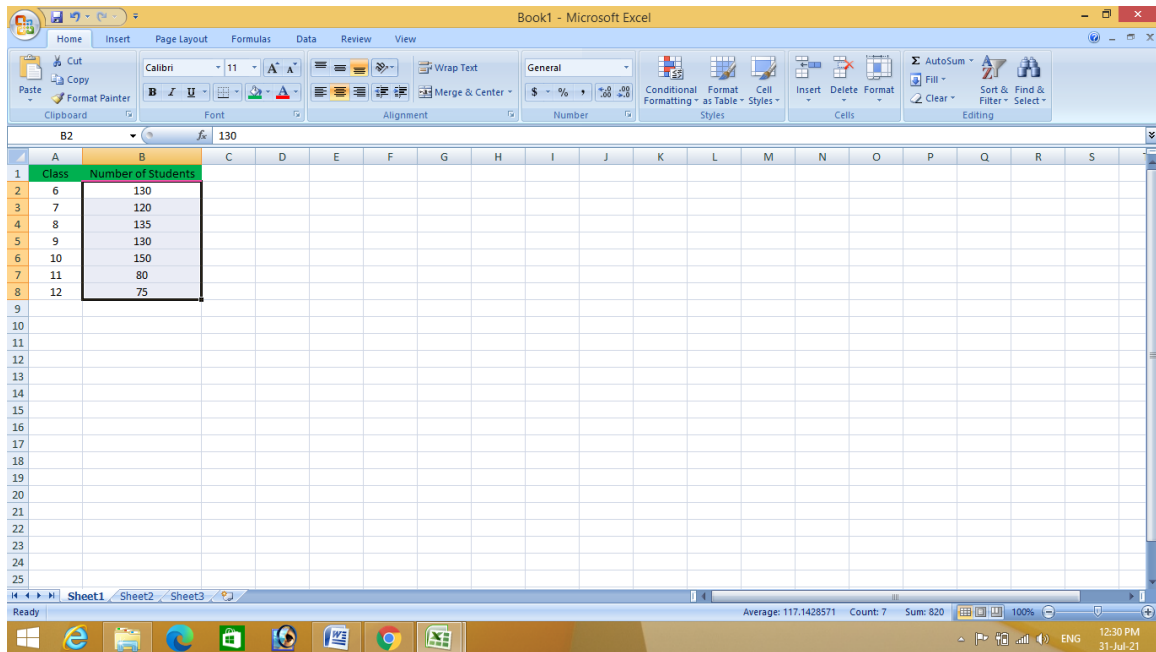


Step 2- Enter the data labels for columns and rows.



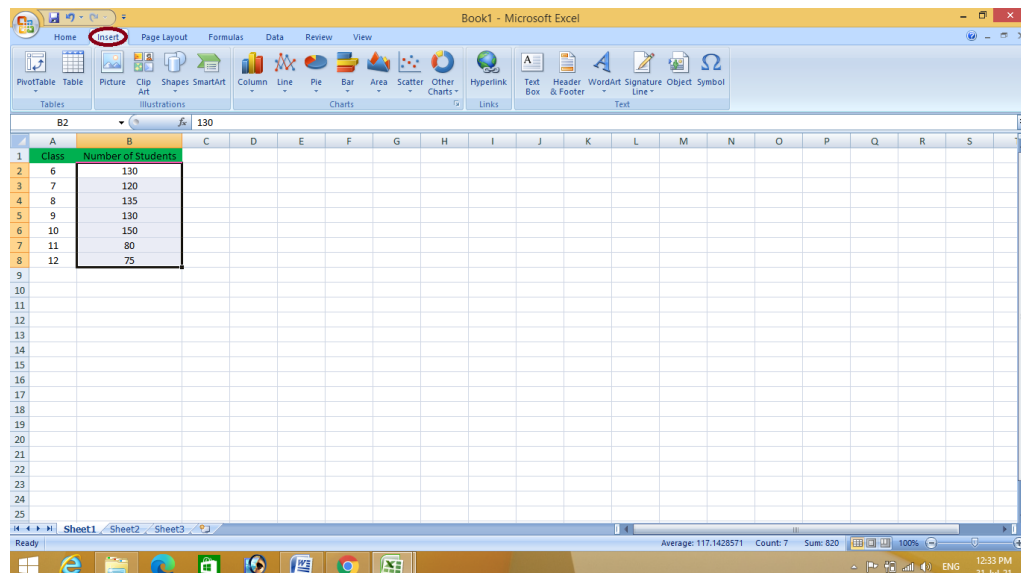
Step 3- Select Range

- I. Highlight the cells that contain the data by clicking and dragging mouse across the cells.
- II. The cell range will now be highlighted in gray and a chart type can be selected.

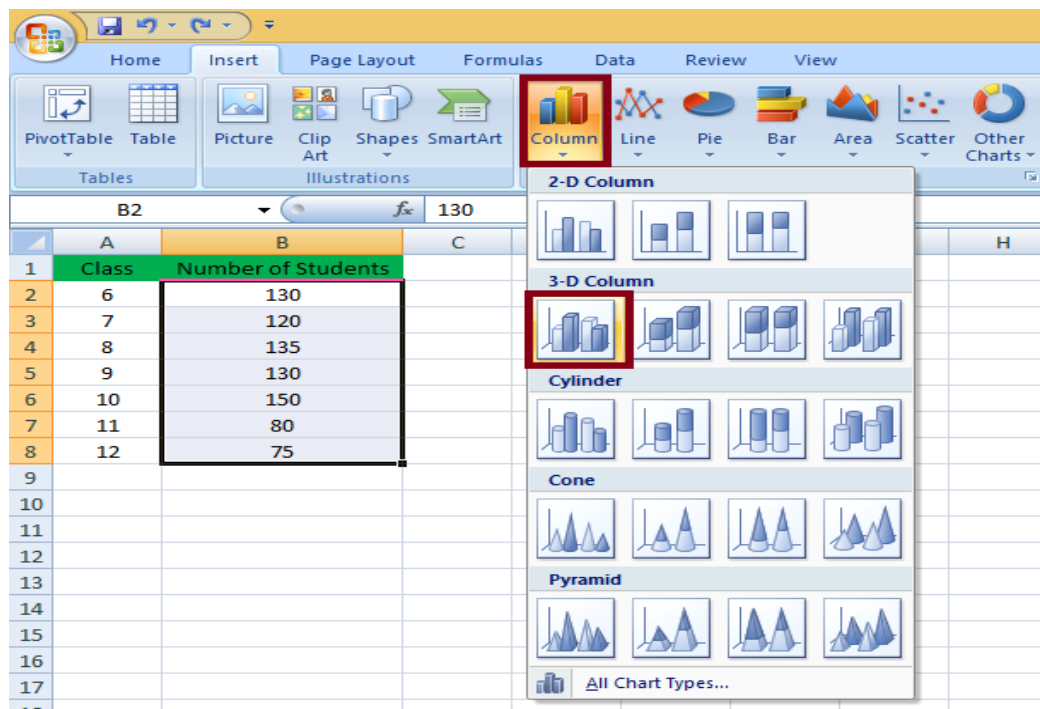


Step 4- Select Chart type

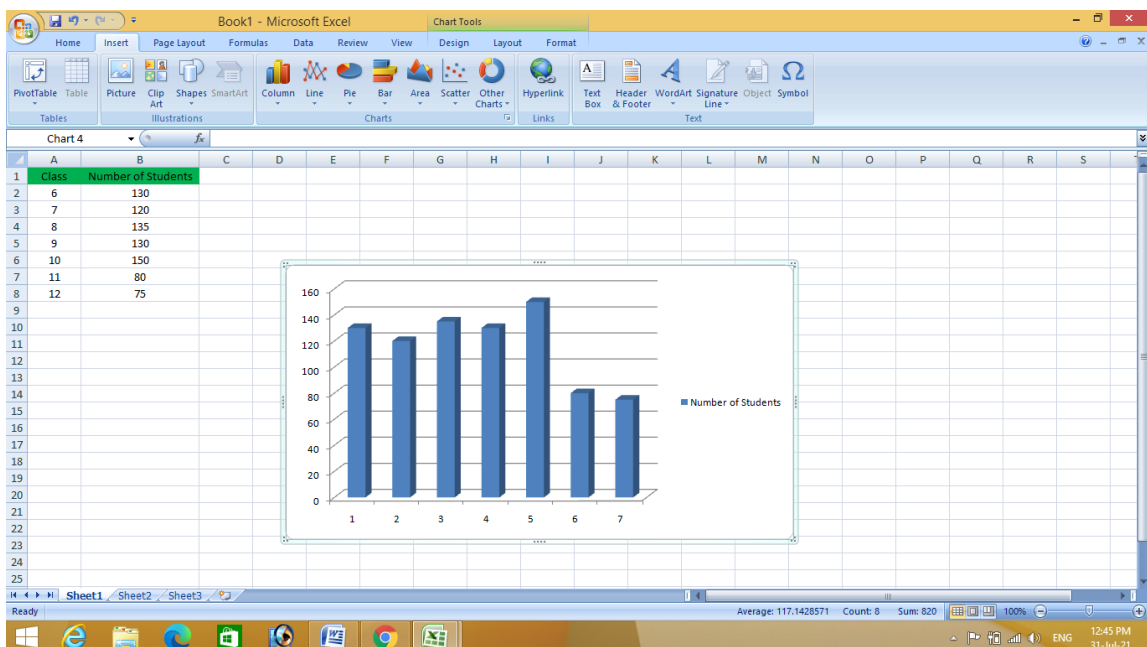
- Click the 'Insert' tab on the top banner. About halfway across the toolbar is a section with several chart options. Excel provides different charts that can be selected by clicking any of the dropdown menus.



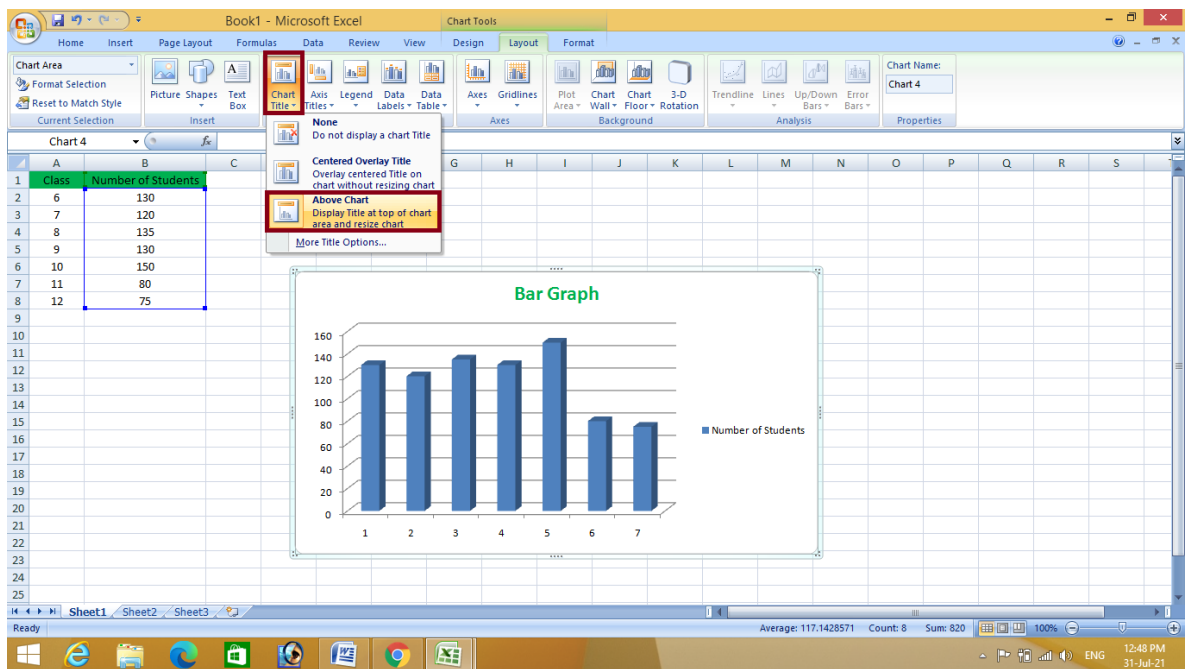
Step 5- Click the ‘Column Chart’ icon and select ‘3-D Column.’



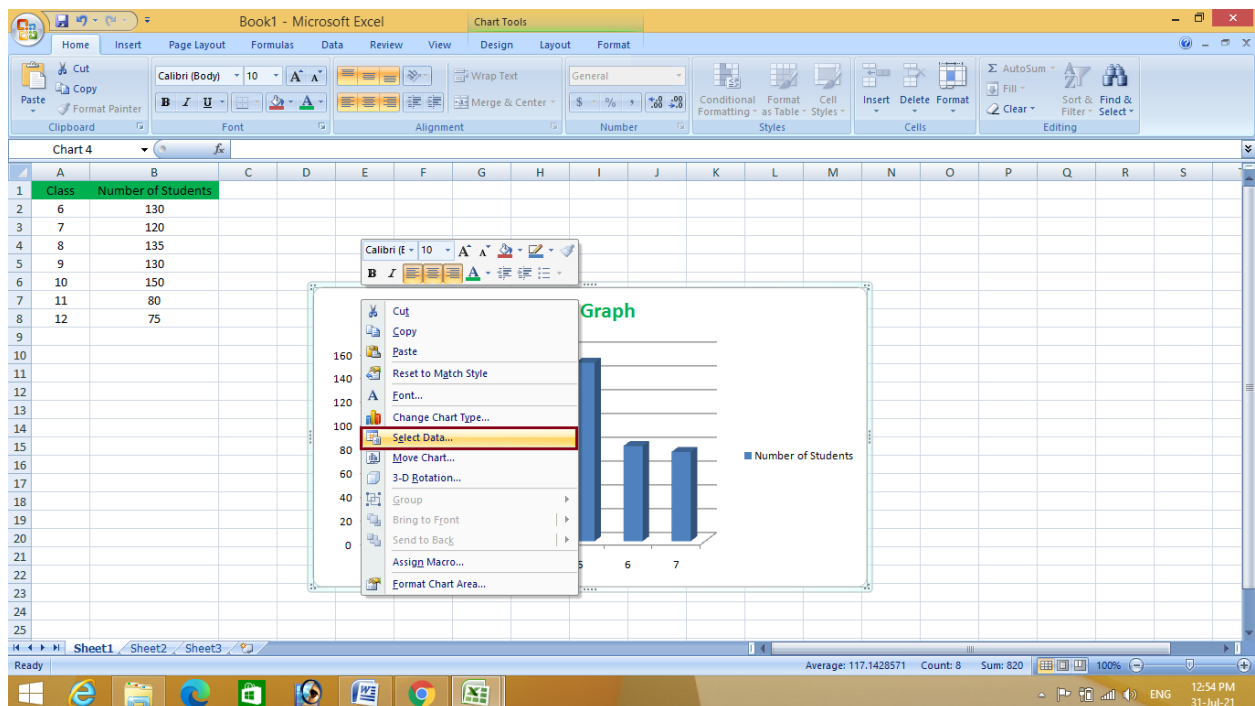
- Excel will automatically create ‘3-D Bar Chart’ from the selected data. The chart will appear in the centre of the workbook.



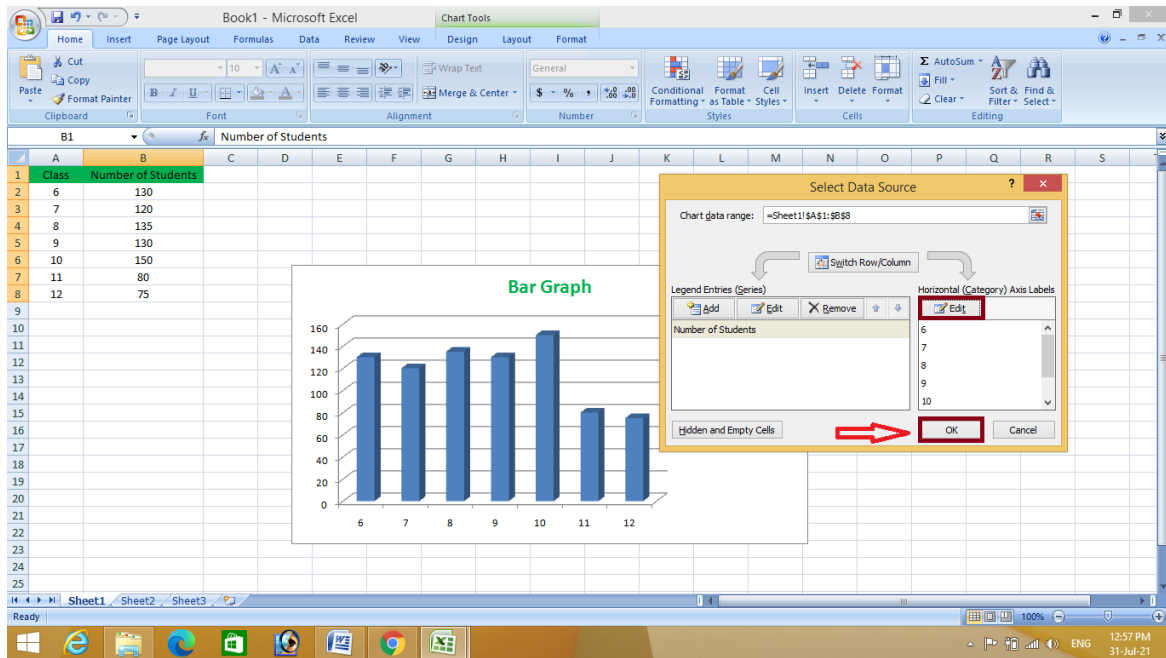
- To name the chart, click on 'Layout' tab and choose the option 'Chart Title' and select the 'Above Chart' from the dropdown menu.



Step 6- Right click the mouse on the inserted graph and choose the option 'Select Data'.



- Click on 'Edit' to fill the horizontal axis data and press.

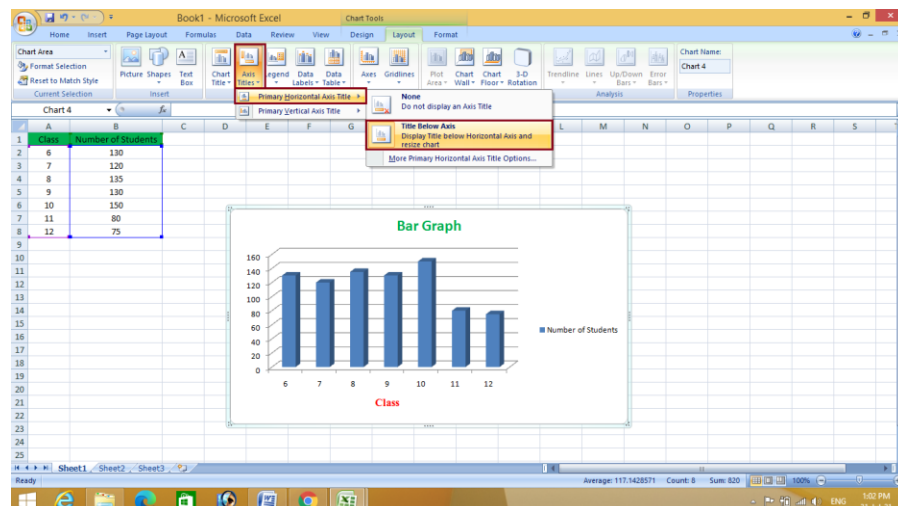


Step 7- Add Chart Elements

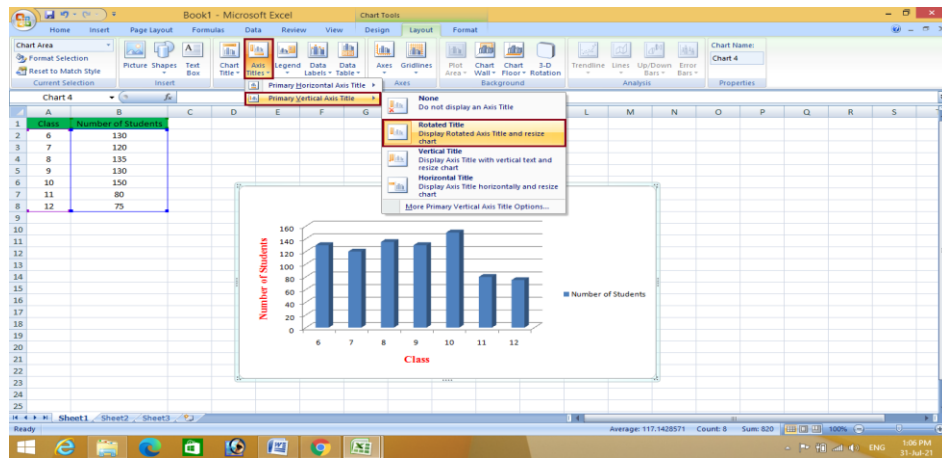
Adding chart elements to the chart or graph will enhance it by clarifying data or providing additional context.

❖ To Add Axis Title:

- To create horizontal axis title, click on 'Layout' tab and choose the option 'Axis Title.' Select the 'Primary Horizontal Axis Title' and 'Title Below Axis' respectively from the dropdown menu. A text box will appear on the chart.

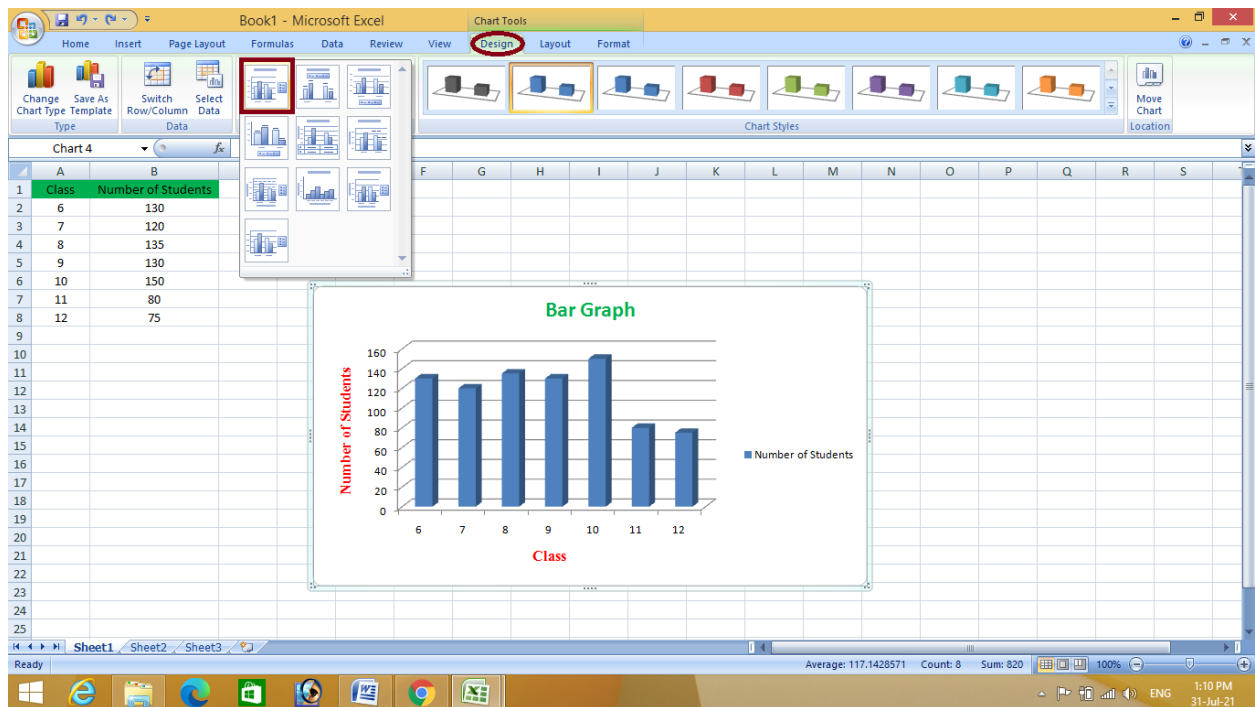


- II. To create vertical axis title, click on 'Layout' tab and choose the option 'Axis Title.' Select the 'Primary Vertical Axis Title' and 'Rotated Title' respectively from the dropdown menu. A text box will appear on the chart.



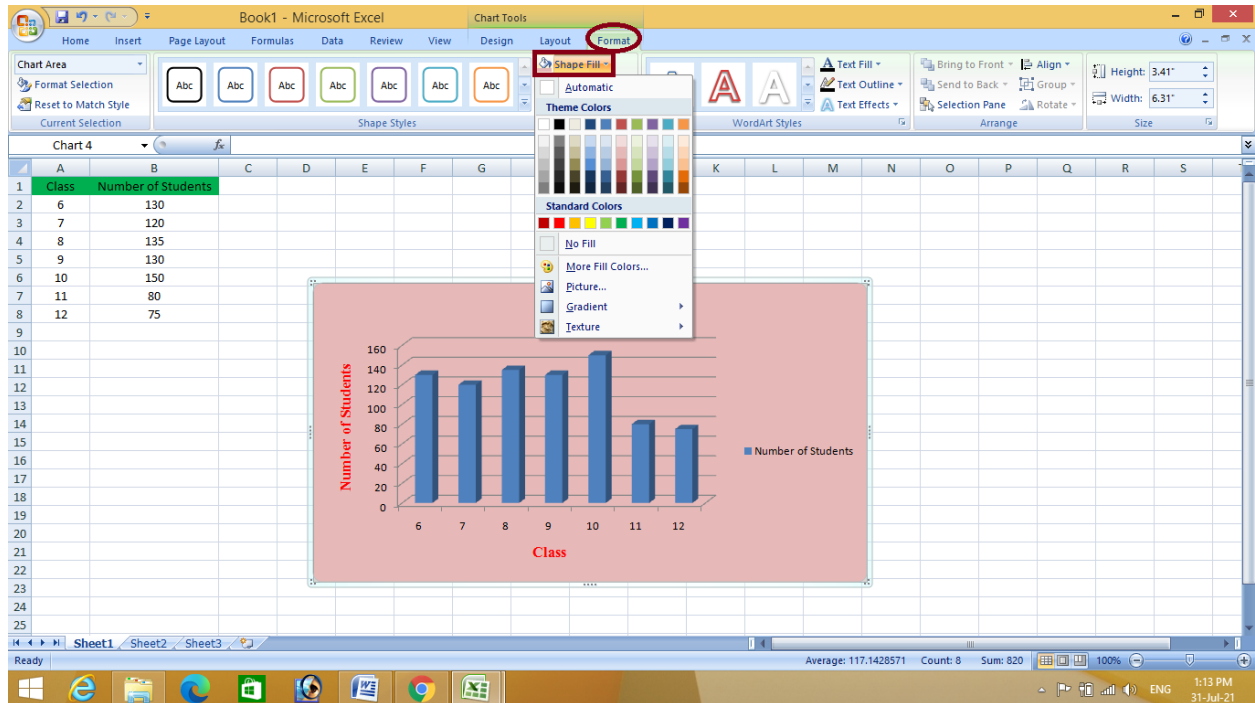
Step 8- Adjust Quick Layout

Click on 'Design' tab to select different layout of graph from the dropdown menu.



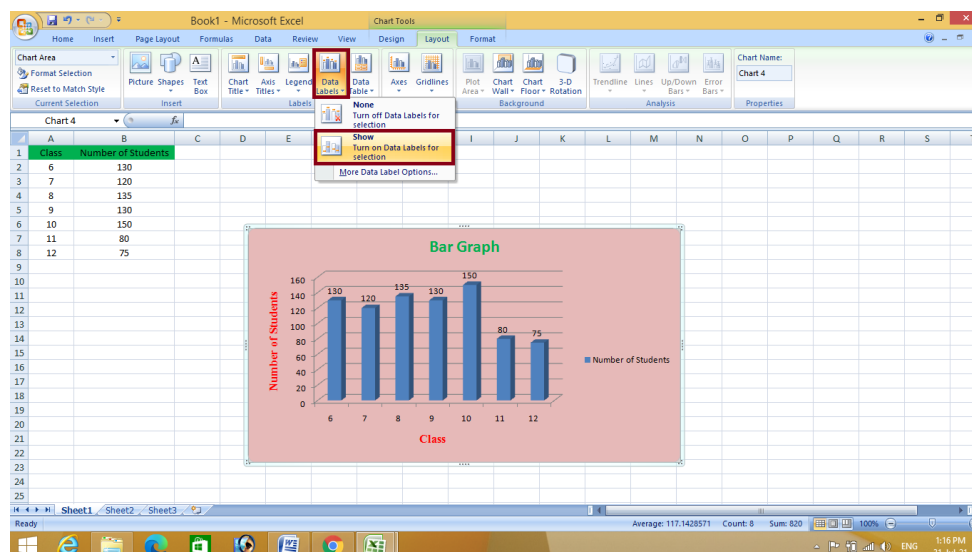
Step 9- Change Formatting

The 'Format' tab allows to change formatting of all elements and text in the chart, including colors, size, shape fill and alignment. Click on 'Format' tab and choose 'Shape Fill' option to format the chart.

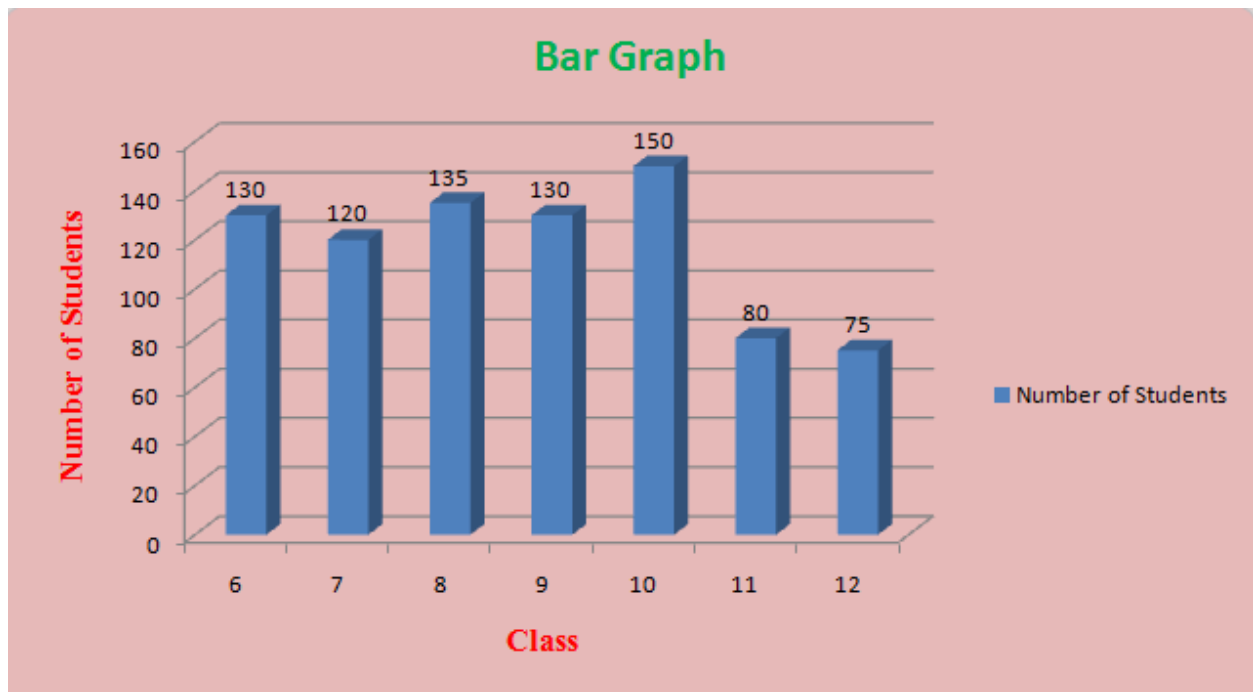


Step 10- To Add Data Labels:

Click on 'Layout' tab and click on 'Data Label.' There are seven options for data labels: None (default), Centre, Left, Right, Above, Below, and More Data label Title Options. Select anyone of them according to choice.



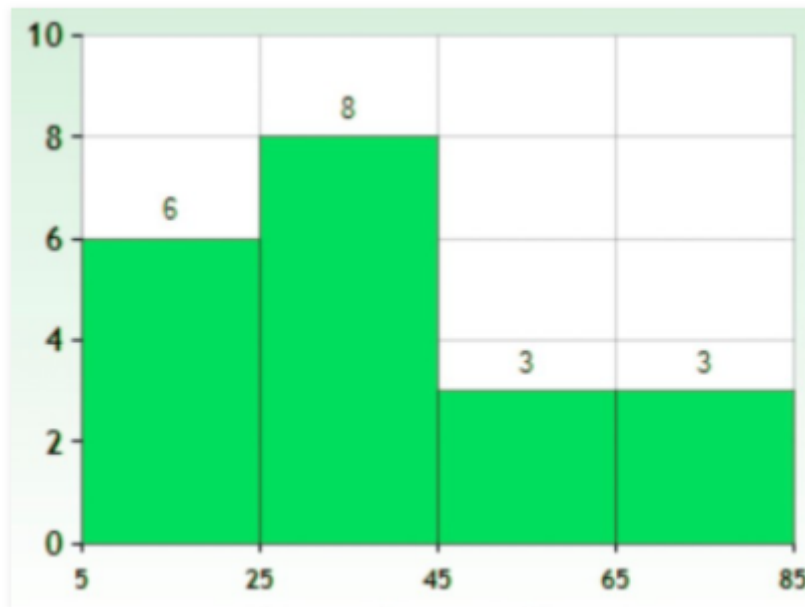
Step 11- Final 'Bar Chart'.



Histograms-

- ❖ A histogram is a graphical representation of a grouped frequency distribution with continuous classes.
- ❖ This is similar to bar graphs, but it is based frequency of numerical values rather than their actual values.
- ❖ The data is organized into intervals and the bars represent the frequency of the values in that range. That is, it counts how many values of the data lie in a particular range.
- ❖ A histogram is used to summarize discrete or continuous data.
- ❖ In other words, it provides a visual interpretation of numerical data by showing the number of data points that fall within a specified range of values (called “bins”).
- ❖ It is similar to a vertical bar graph. However, a histogram, unlike a vertical bar graph, shows no gaps between the bars.

- ❖ It is an area diagram and can be defined as a set of rectangles with bases along with the intervals between class boundaries and with areas proportional to frequencies in the corresponding classes.
- ❖ In such representations, all the rectangles are adjacent since the base covers the intervals between class boundaries. The heights of rectangles are proportional to corresponding frequencies of similar classes and for different classes; the heights will be proportional to corresponding frequency densities.
- ❖ In other words, histogram a diagram involving rectangles whose area is proportional to the frequency of a variable and width is equal to the class interval.



Parts of a Histogram

1. **The title:** The title describes the information included in the histogram.
2. **X-axis:** The X-axis are intervals that show the scale of values which the measurements fall under.
3. **Y-axis:** The Y-axis shows the number of times that the values occurred within the intervals set by the X-axis.
4. **The bars:** The height of the bar shows the number of times that the values occurred within the interval, while the width of the bar shows the interval that is covered. For a histogram with equal bins, the width should be the same across all bars.

When to Use Histogram?

The histogram graph is used under certain conditions. They are:

- The data should be numerical.
- A histogram is used to check the shape of the data distribution.
- Used to check whether the process changes from one period to another.
- Used to determine whether the output is different when it involves two or more processes.
- Used to analyze whether the given process meets the customer requirements.

Importance of a Histogram

- Creating a histogram provides a visual representation of data distribution.
- Histograms can display a large amount of data and the frequency of the data values.
- The median and distribution of the data can be determined by a histogram.
- In addition, it can show any outliers or gaps in the data.

Distributions of a Histogram

A normal distribution: In a normal distribution, points on one side of the average are as likely to occur as on the other side of the average.



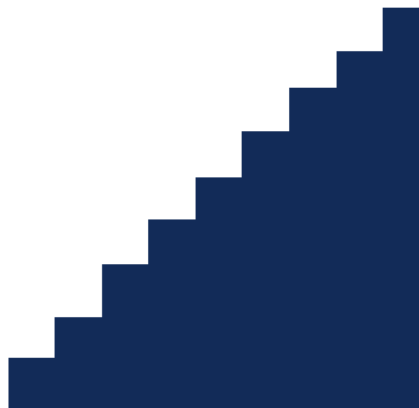
A bimodal distribution: In a bimodal distribution, there are two peaks. In a bimodal distribution, the data should be separated and analyzed as separate normal distributions.



A right-skewed distribution: A right-skewed distribution is also called a positively skewed distribution. In a right-skewed distribution, a large number of data values occur on the left side with a fewer number of data values on the right side. A right-skewed distribution usually occurs when the data has a range boundary on the left-hand side of the histogram. For example, a boundary of 0.



A left-skewed distribution: A left-skewed distribution is also called a negatively skewed distribution. In a left-skewed distribution, a large number of data values occur on the right side with a fewer number of data values on the left side. A right-skewed distribution usually occurs when the data has a range boundary on the right-hand side of the histogram. For example, a boundary such as 100.



A random distribution: A random distribution lacks an apparent pattern and has several peaks. In a random distribution histogram, it can be the case that different data properties were combined. Therefore, the data should be separated and analyzed separately.



Difference between Histogram and Bar Graph

A histogram is one of the most commonly used graphs to show the frequency distribution. As we know that the frequency distribution defines how often each different value occurs in the data set. The histogram looks more similar to the bar graph, but there is a difference between them. Although histograms seem similar to bar graph, there is a slight difference between them. The histogram does not involve any gaps between the two successive bars.

The list of difference between the bar graph and the histogram is given below:

| Histogram | Bar Graph |
|--|--|
| It is a two-dimensional figure | It is a one-dimensional figure |
| The frequency is shown by the area of each rectangle | The height shows the frequency and the width has no significance. |
| It shows rectangles touching each other | It consists of rectangles separated from each other with equal spaces. |

How to Make Histogram?

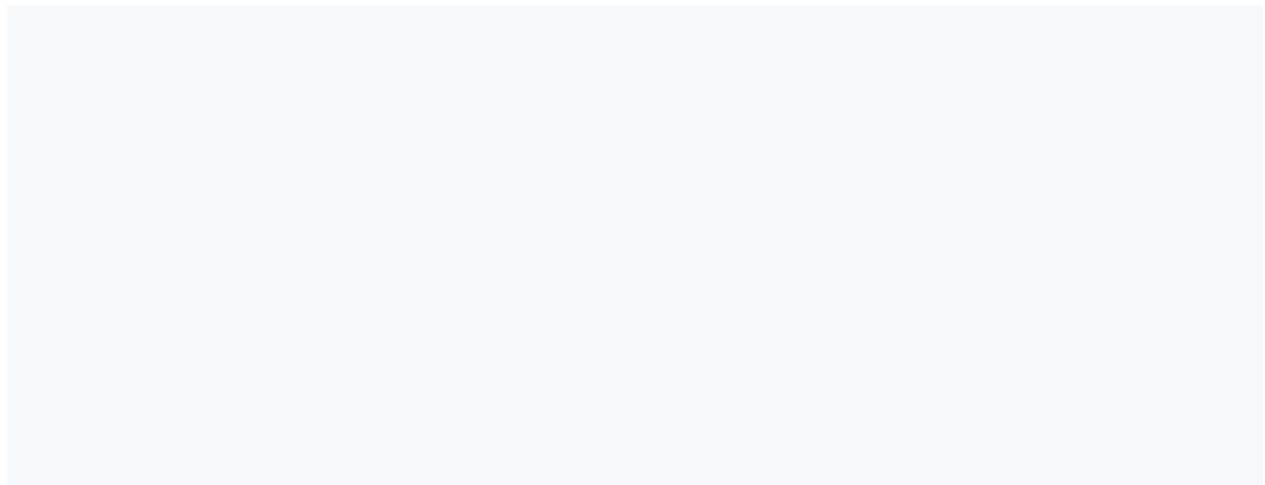
Follow the below steps to construct a histogram-

1. Begin by marking the class intervals on the X-axis and frequencies on the Y-axis.
2. The scales for both the axes have to be the same.
3. Class intervals need to be exclusive.
4. Draw rectangles with bases as class intervals and corresponding frequencies as heights.
5. A rectangle is built on each class interval since the class limits are marked on the horizontal axis, and the frequencies are indicated on the vertical axis.
6. The height of each rectangle is proportional to the corresponding class frequency if the intervals are equal.
7. The area of every individual rectangle is proportional to the corresponding class frequency if the intervals are unequal.

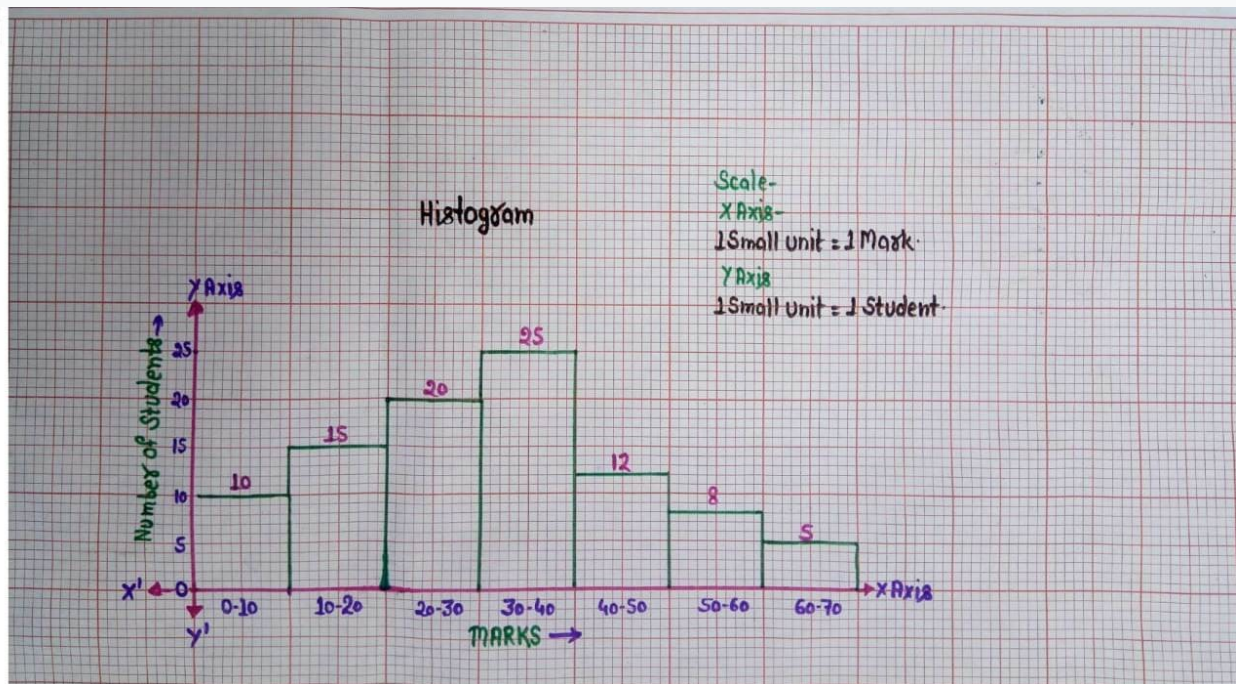
Example:

Draw a histogram for the following table which represents the marks obtained by 100 students in an examination:

| Marks | 0-10 | 10-20 | 20-30 | 30-40 | 40-50 | 50-60 | 60-70 | 70-80 |
|--------------------|------|-------|-------|-------|-------|-------|-------|-------|
| Number of students | 10 | 10 | 15 | 20 | 25 | 12 | 8 | 5 |

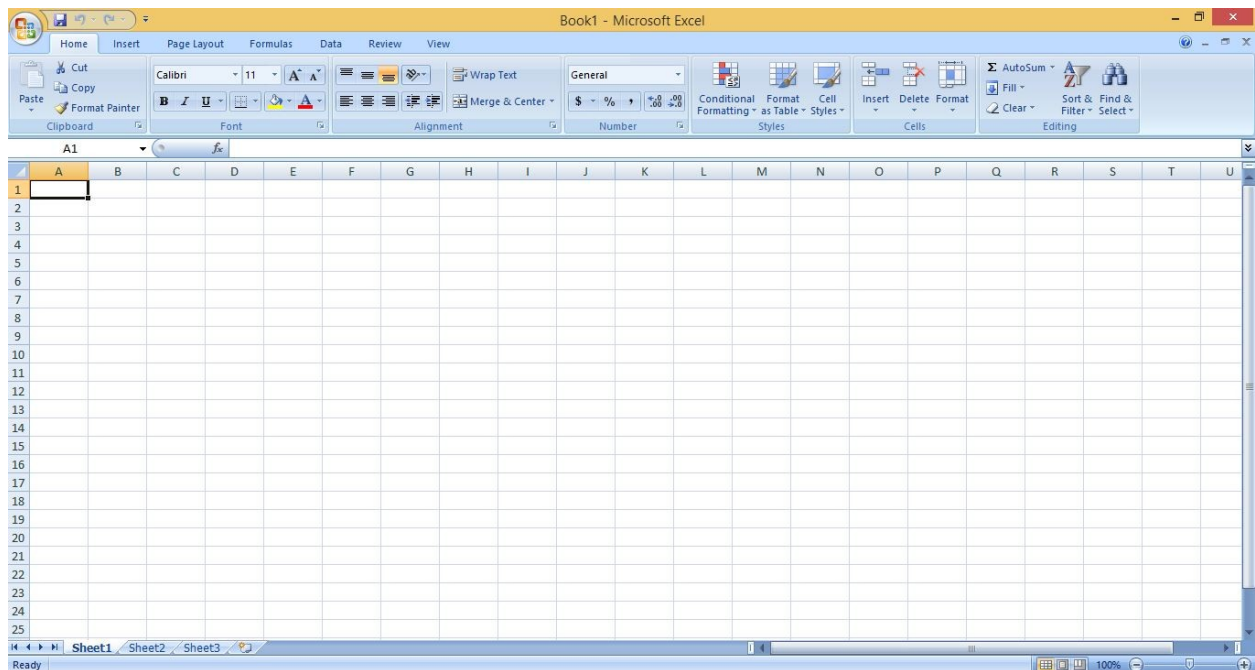


Answer-

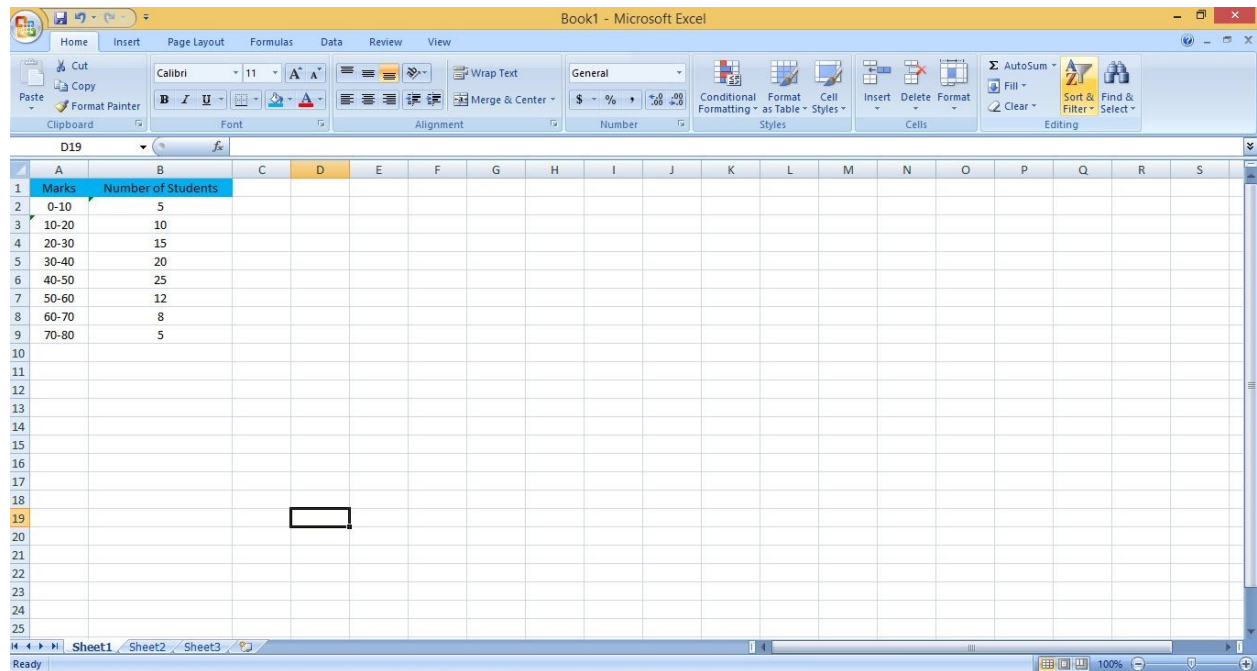


Construction of 'Histogram' through MS Excel-

Step 1- Open 'MS Excel' and select 'New Workbook'.

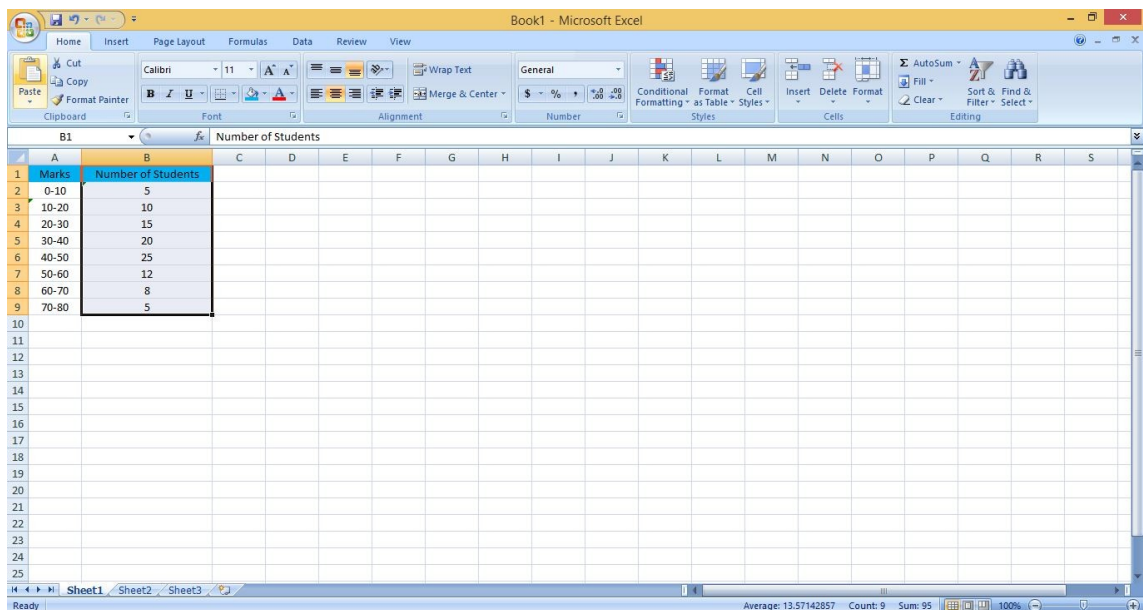


Step 2- Enter the data labels for columns and rows.



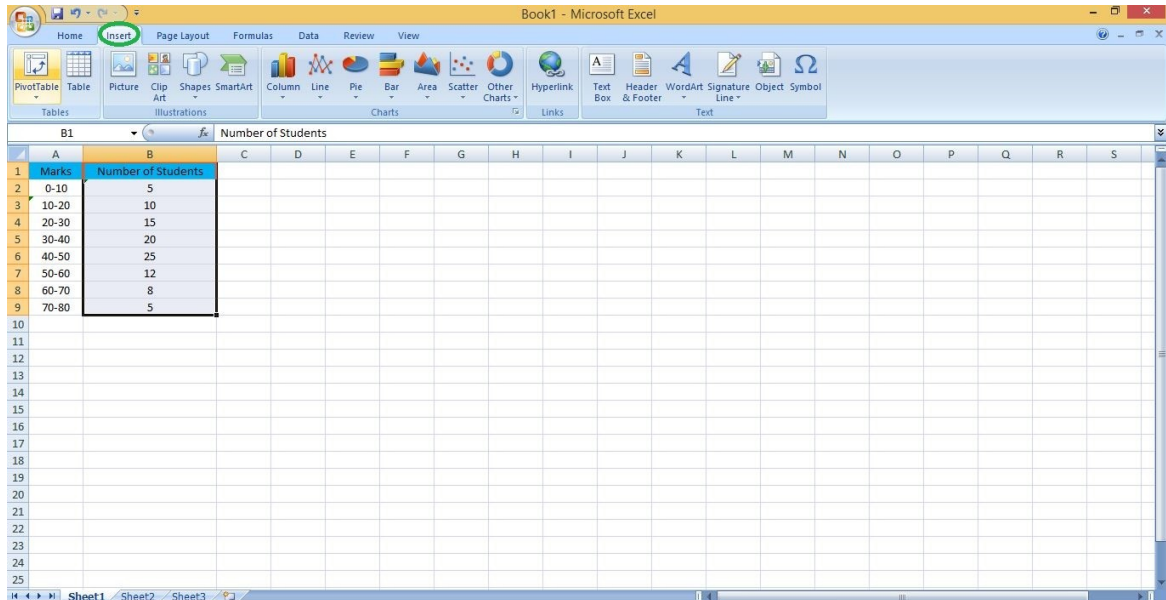
Step 3- Select Range

- Highlight the cells that contain the data by clicking and dragging mouse across the cells.
- The cell range will now be highlighted in gray and a chart type can be selected.

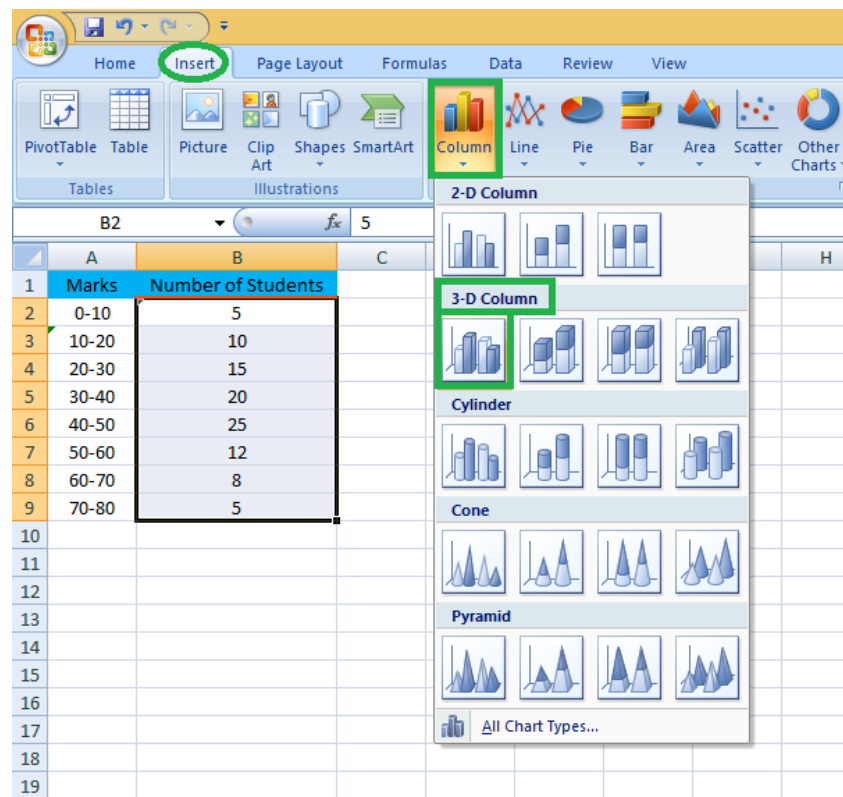


Step 4- Select Chart type

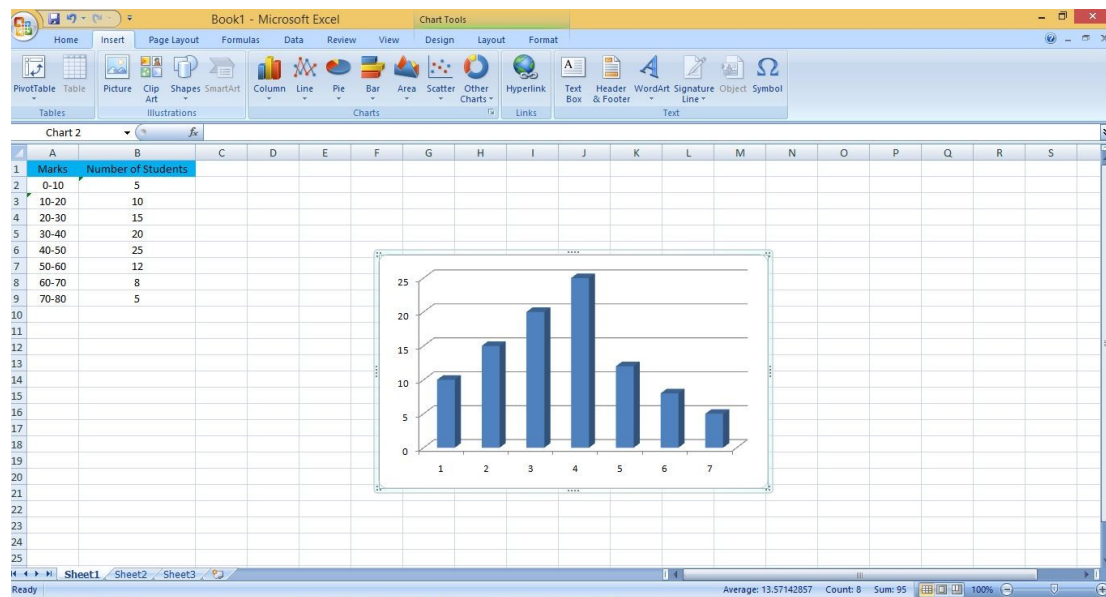
- Click the 'Insert' tab on the top banner. About halfway across the toolbar is a section with several chart options. Excel provides different charts that can be selected by clicking any of the dropdown menus.



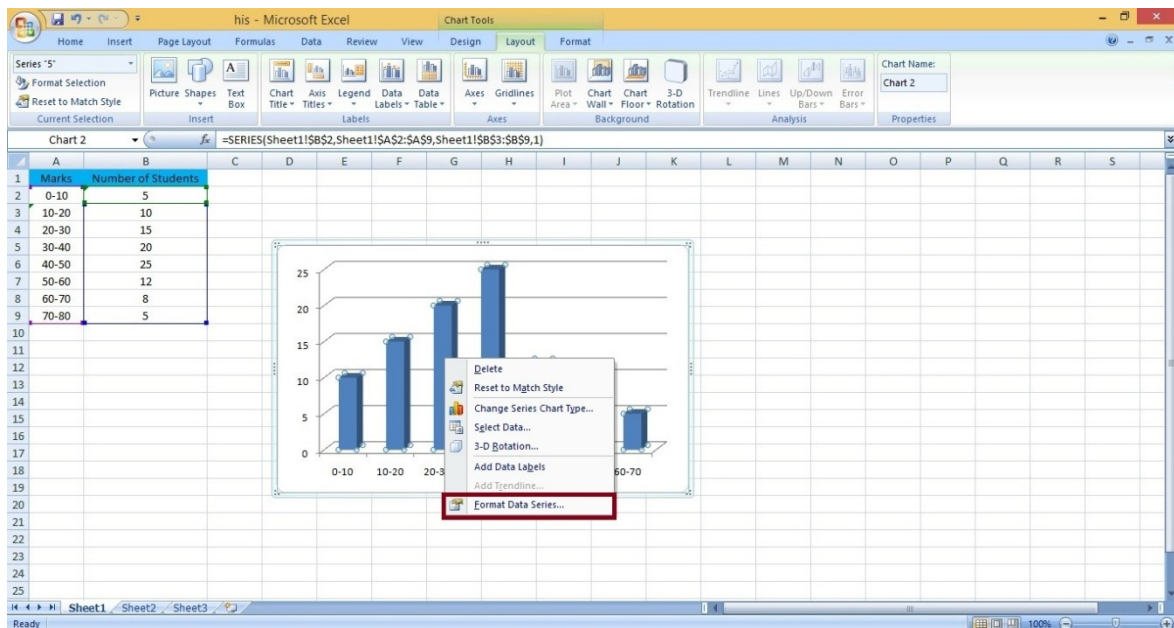
Step 5- Click the 'Column Chart' icon and select '3-D Column.'



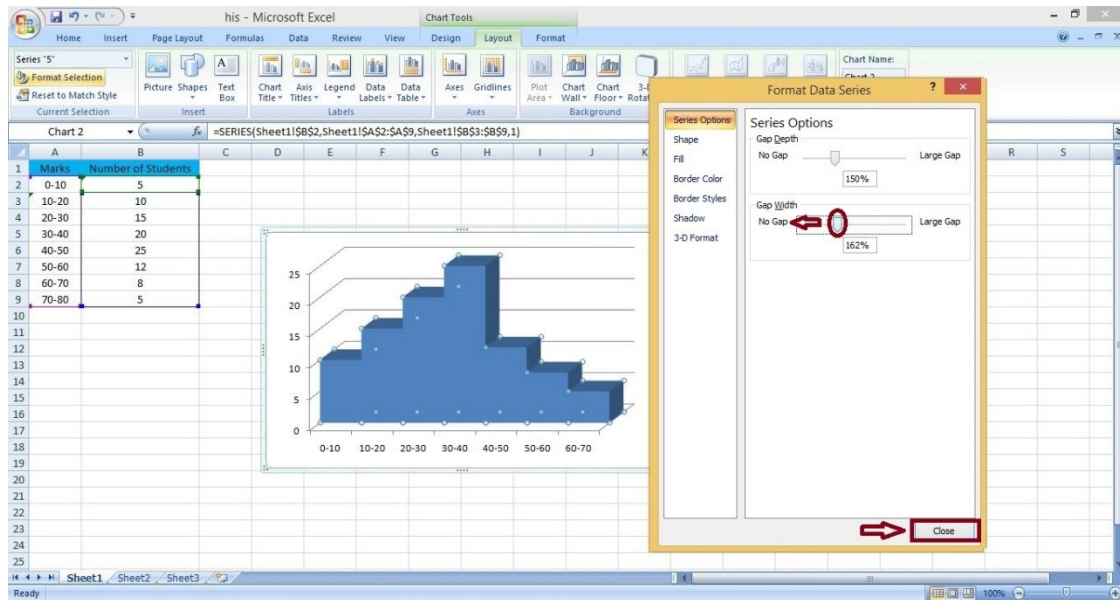
- Excel will automatically create a '3-D Line Chart' from the selected data. The chart will appear in the centre of the workbook.



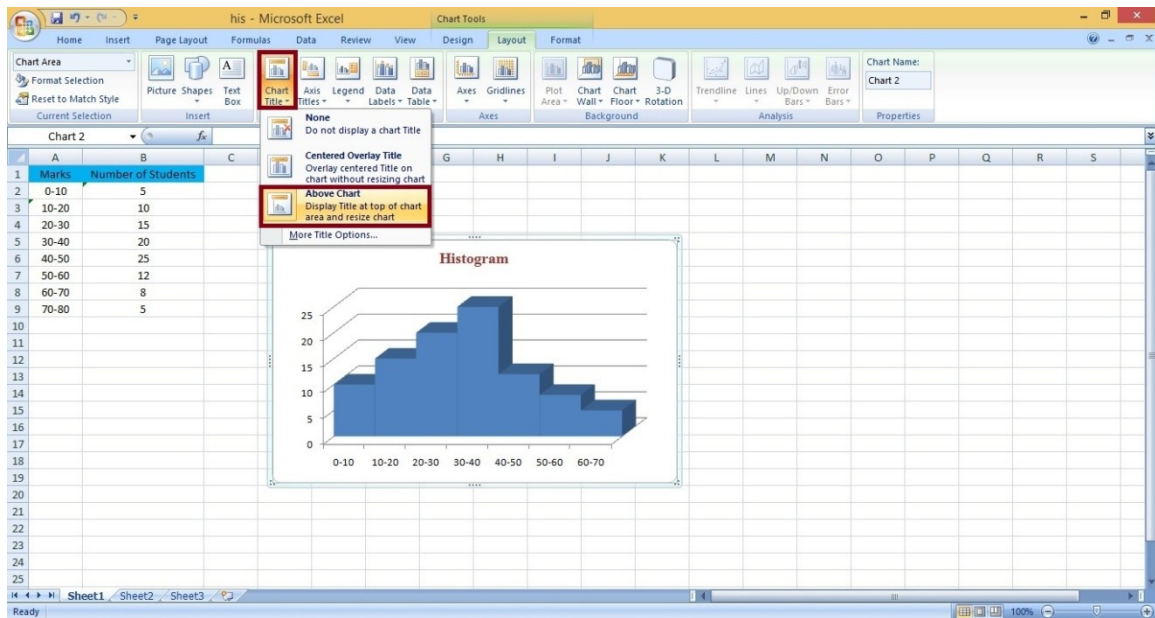
- Right click the mouse and click on 'Format Data Series' option.



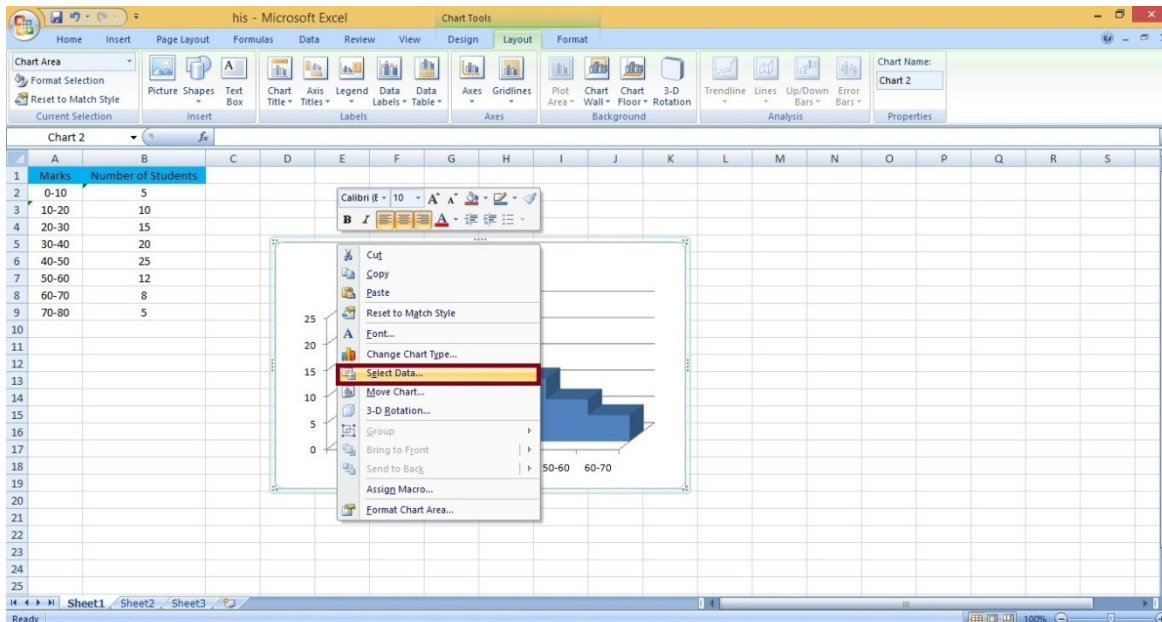
- Go to 'Gap Width' and scroll bar toward– 'No Gap' (0%).



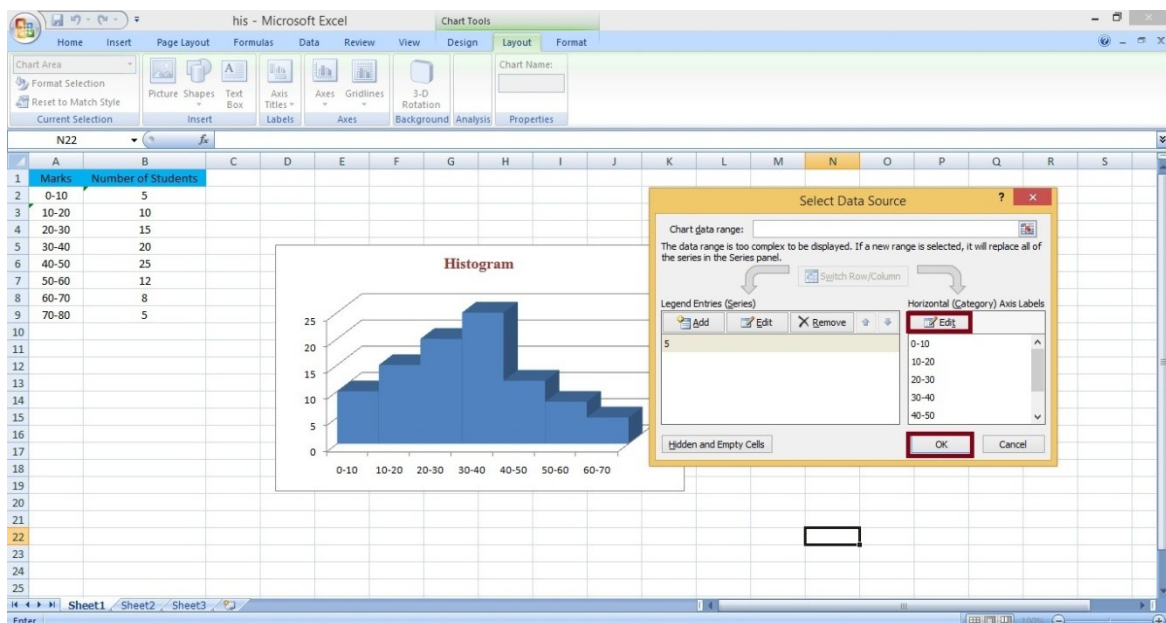
- To name the chart, click on 'Layout' tab and choose the option 'Chart Title' and select the 'Above Chart' from the dropdown menu.



Step 6- Right click the mouse on the inserted graph and choose the option ‘Select Data’.



❖ Click on ‘Edit’ to fill the horizontal axis data.

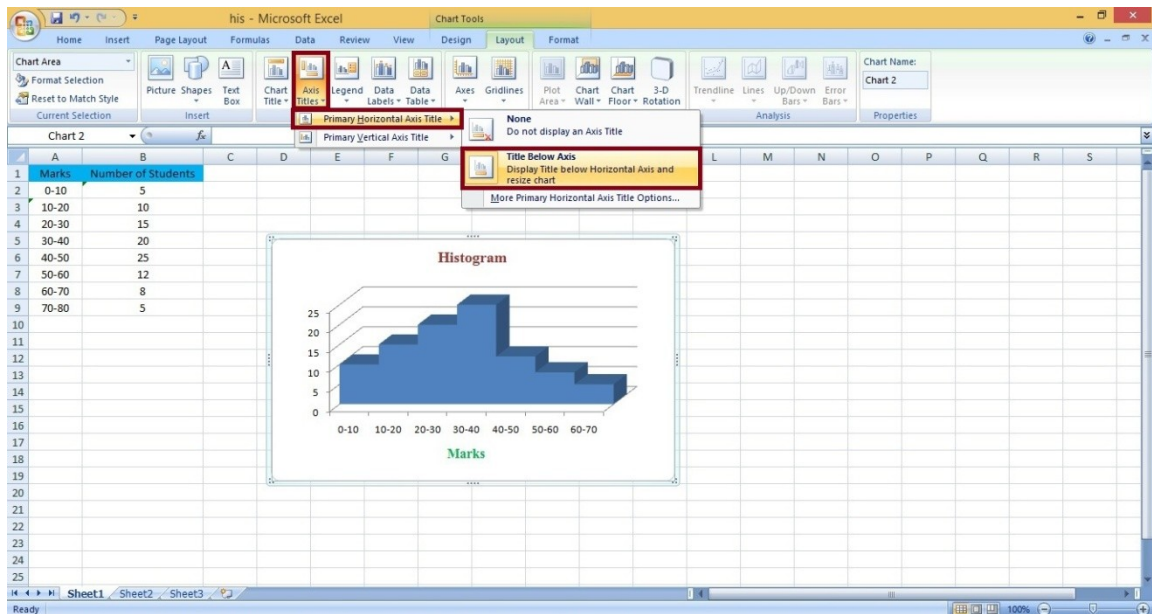


Step 7- Add Chart Elements

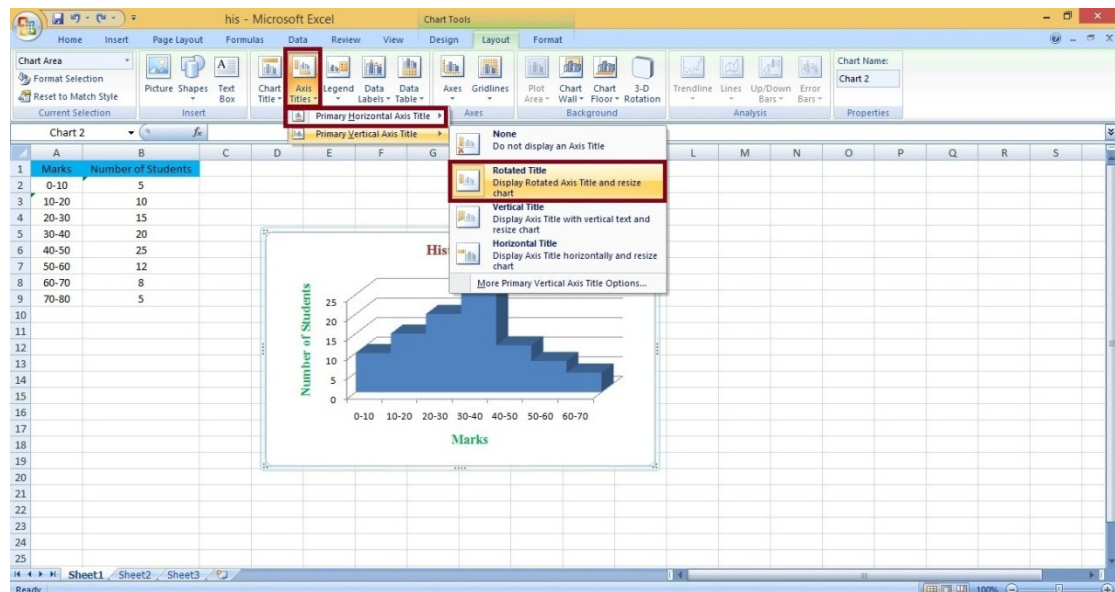
Adding chart elements to the chart or graph will enhance it by clarifying data or providing additional context.

❖ To Add Axis Title:

- i. To create horizontal axis title, click on 'Layout' tab and choose the option 'Axis Title.' Select the 'Primary Horizontal Axis Title' and 'Title Below Axis' respectively from the dropdown menu. A text box will appear on the chart.

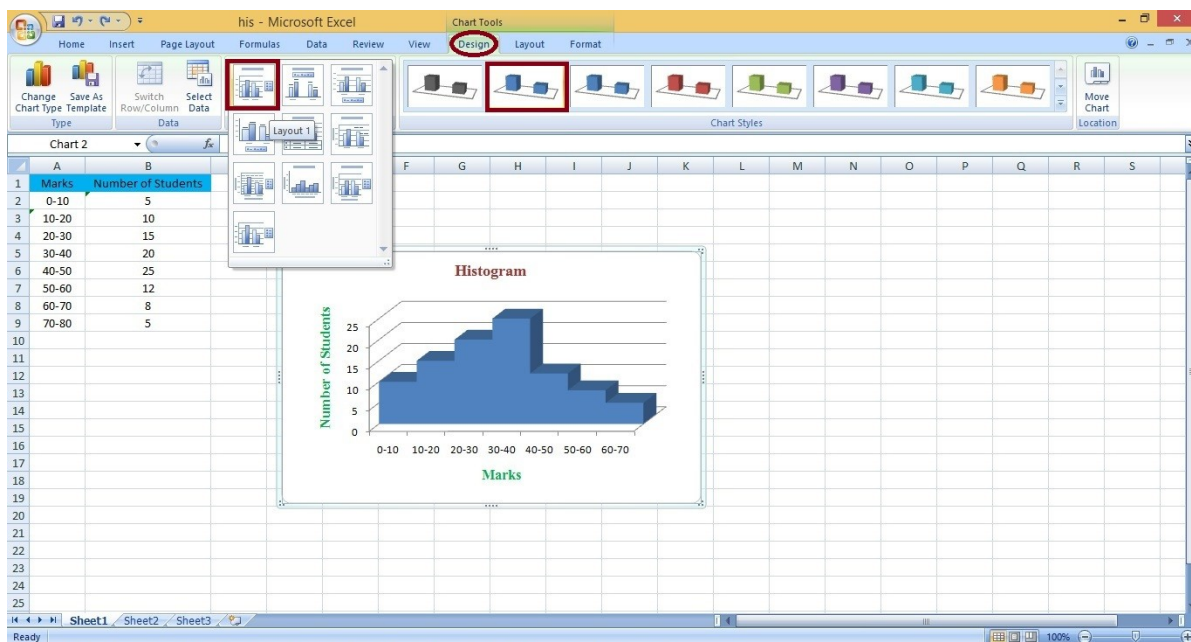


- ii. To create vertical axis title, click on 'Layout' tab and choose the option 'Axis Title.' Select the 'Primary Vertical Axis Title' and 'Rotated Title' respectively from the dropdown menu. A text box will appear on the chart.



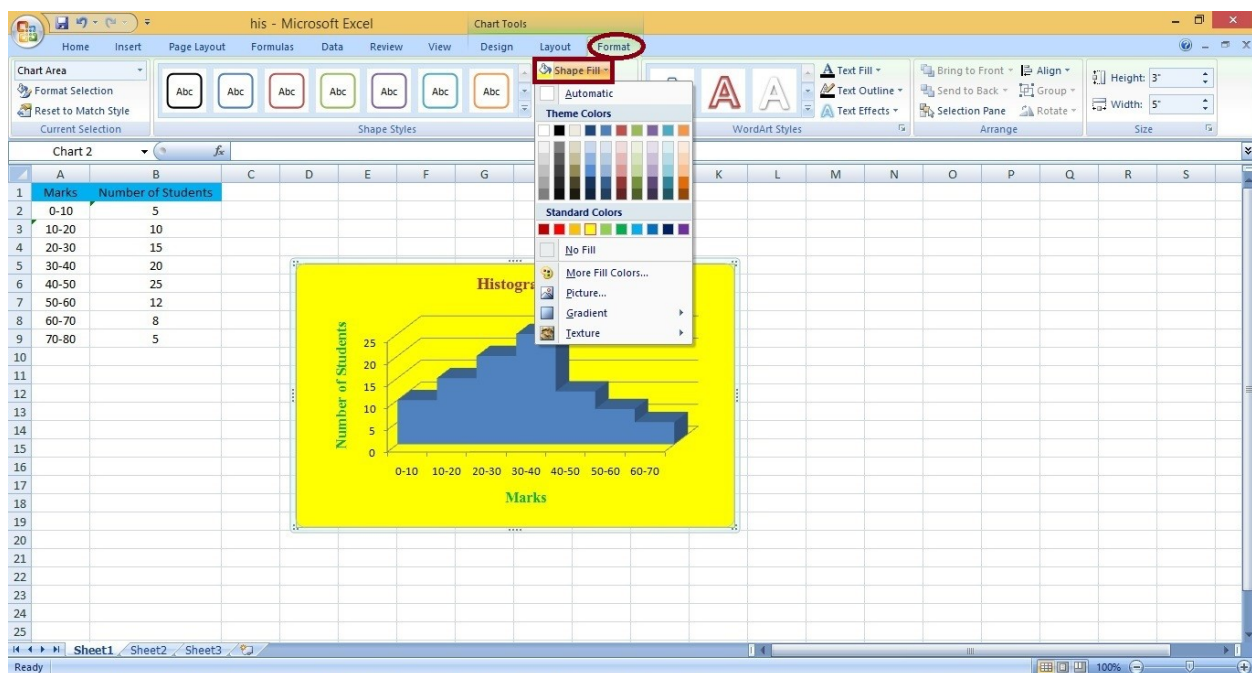
Step 8- Adjust Quick Layout

Click on 'Design' tab to select different layout of graph from the dropdown menu.



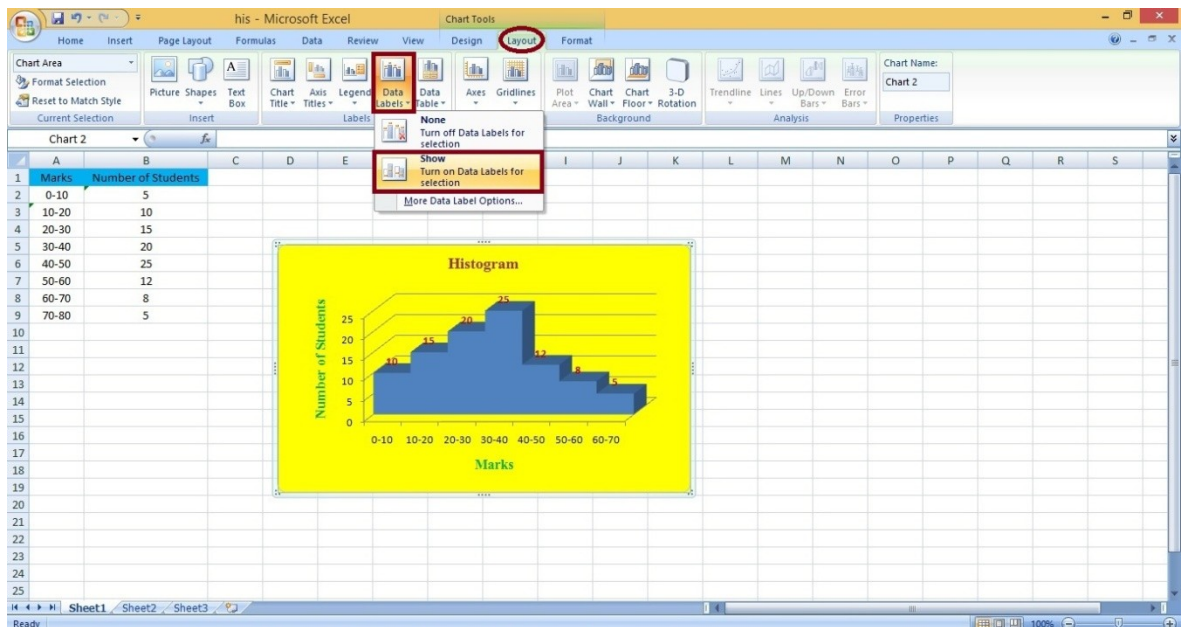
Step 9- Change Formatting

The 'Format' tab allows to change formatting of all elements and text in the chart, including colors, size, shape fill and alignment. Click on 'Format' tab and choose 'Shape Fill' option to format the chart.

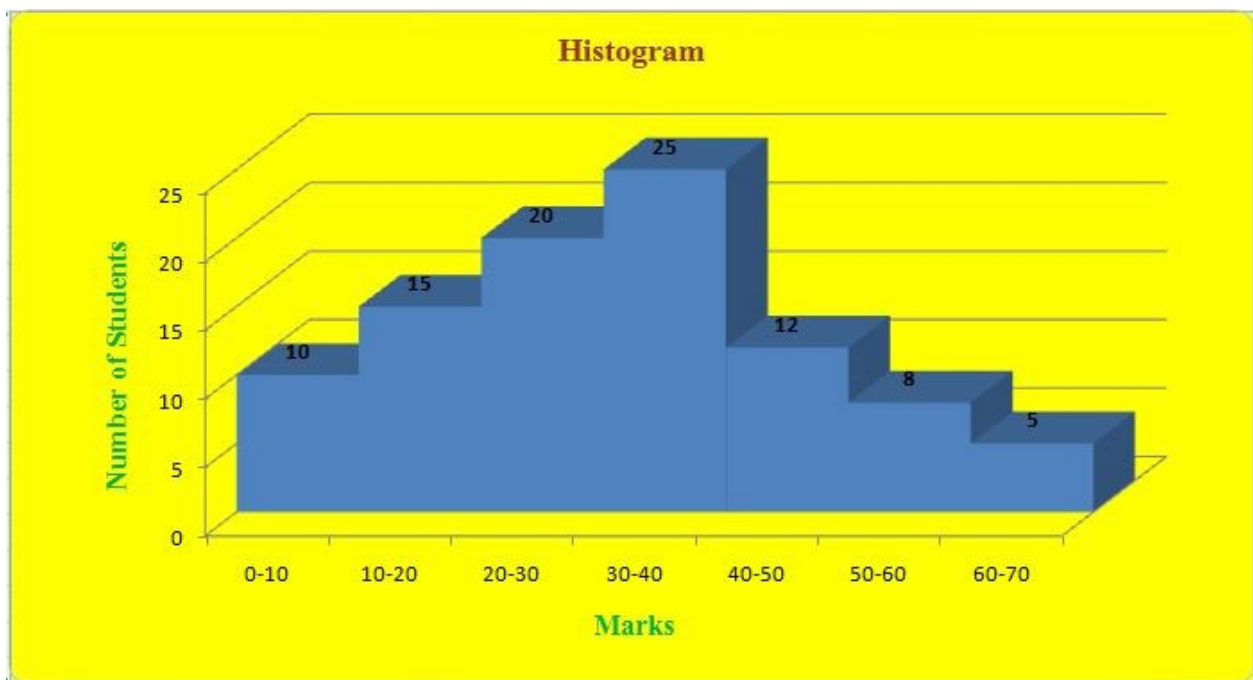


Step 10- To Add Data Labels:

Click on 'Layout' tab and click on 'Data Label.' There are seven options for data labels: None (default), Centre, Left, Right, Above, Below, and More Data label Title Options. Select anyone of them according to choice.



Step 11- Final 'Histogram' graph.



Circle or Pie Chart-

- ❖ A pie chart is a type of graph that represents the data in the circular graph.
- ❖ It is a type of graph which represents the data in form of a circular graph.
- ❖ The circle is divided such that each portion represents a proportion of the whole.
- ❖ The pieces of the graph are proportional to the fraction of the whole in each category.
- ❖ In other words, each slice of the pie is relative to the size of that category in the group as a whole.
- ❖ The entire **pie** represents **100 percent** of a whole; while the pie **slices** represent portions of the whole.
- ❖ The slices of pie show the relative size of the data.
- ❖ It is a type of pictorial representation of data.
- ❖ A pie chart requires a list of categorical variables and the numerical variables.
- ❖ Here, the term “pie” represents the whole, and the “slices” represent the parts of the whole.
- ❖ The “**pie chart**” is also known as ‘circle chart’ that divides the circular statistical graphic into sectors or slices in order to illustrate the numerical problems.
- ❖ Each sector denotes a proportionate part of the whole.
- ❖ To find out the composition of something, Pie-chart works the best at that time.
- ❖ In most cases, pie charts replace some other graphs like the bar graph, line plots, histograms, etc.



Formula

The pie chart is an important type of data representation. It contains different segments and sectors in which each segment and sectors of a pie chart forms a certain portion of the total (percentage). The total of all the data is equal to 360° .

The total value of the pie is always 100%.

To work out with the percentage for a pie chart, follow the steps given below:

- Categorize the data
- Calculate the total
- Divide the categories
- Convert into percentages
- Finally, calculate the degrees

Therefore, the pie chart formula is given as

$$(\text{Given Data}/\text{Total value of Data}) \times 360^\circ.$$

How to Create a Pie Chart?

Imagine a teacher surveys her class on the basis of their favorite Sports:

| Football | Hockey | Cricket | Basketball | Badminton |
|----------|--------|---------|------------|-----------|
| 10 | 5 | 5 | 10 | 10 |

The data above can be represented by a pie-chart as following and by using the circle graph formula, i.e. the pie chart formula given below. It makes the size of portion easy to understand.

Step 1: First, Enter the data into the table.

| Football | Hockey | Cricket | Basketball | Badminton |
|----------|--------|---------|------------|-----------|
| 10 | 5 | 5 | 10 | 10 |

Step 2: Add all the values in the table to get the total.

i.e. Total students are 40 in this case.

Step 3: Next, divide each value by the total and multiply by 100 to get a percent:

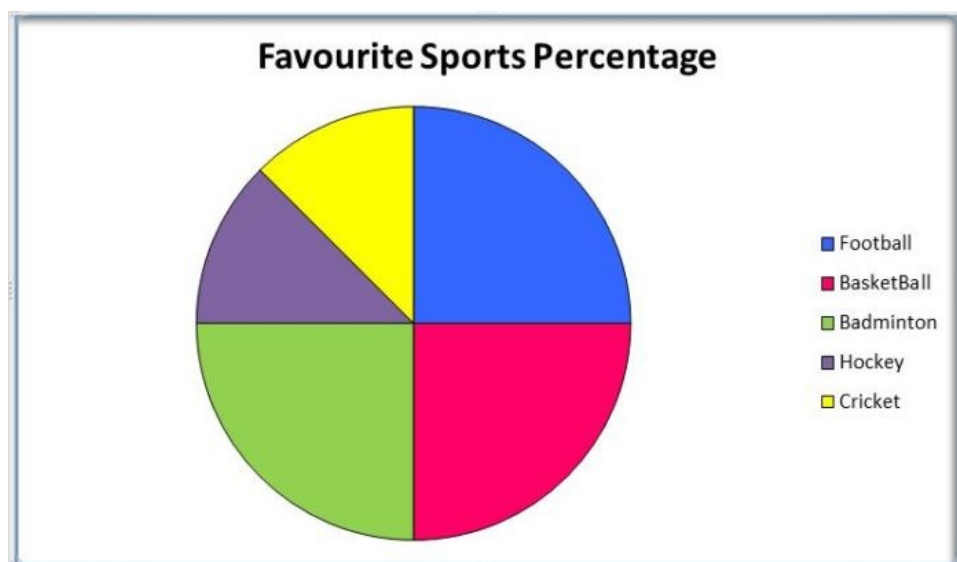
| Football | Hockey | Cricket | Basketball | Badminton |
|------------------------------|-------------------------------|-------------------------------|------------------------------|------------------------------|
| $(10/40) \times 100$ =25% | $(5/40) \times 100$ =12.5% | $(5/40) \times 100$ =12.5% | $(10/40) \times 100$ =25% | $(10/40) \times 100$ =25% |

Step 4: Next to know how many degrees for each “pie sector” we need, we will take a full circle of 360° and follow the calculations below:

The central angle of each component = (Value of each component/sum of values of all the components) $\times 360^\circ$

| Football | Hockey | Cricket | Basketball | Badminton |
|------------------------------------|-----------------------------------|-----------------------------------|------------------------------------|------------------------------------|
| $(10/40) \times 360^\circ$ =90° | $(5/40) \times 360^\circ$ =45° | $(5/40) \times 360^\circ$ =45° | $(10/40) \times 360^\circ$ =90° | $(10/40) \times 360^\circ$ =90° |

Step 5: Draw a circle and use the protractor to measure the degree of each sector.



Uses of Pie Chart

- Within a business, it is used to compare areas of growth, such as turnover, profit and exposure.
- To represent categorical data

Advantages

- The picture is simple and easy-to-understand.
- Data can be represented visually as a fractional part of a whole.
- It helps in providing an effective communication tool for the even uninformed audience.
- Provides a data comparison for the audience at a glance to give an immediate analysis or to quickly understand information.
- No need for readers to examine or measure underlying numbers them, which can be removed by using this chart.
- To emphasize a few points you want to make, you can manipulate pieces of data in the pie chart.

Disadvantages

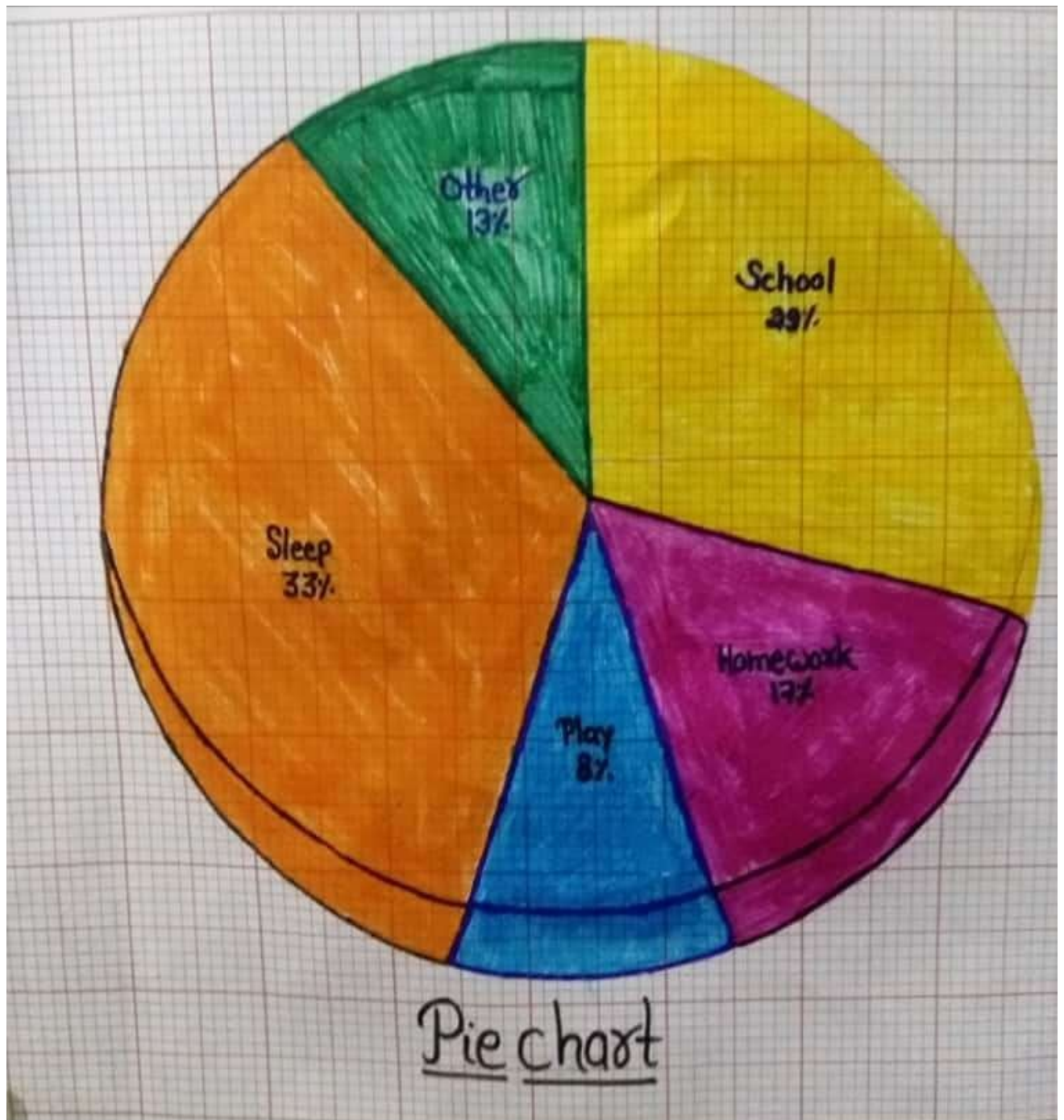
- It becomes less effective, if there are too many pieces of data to use.
- If there are too many pieces of data. Even if you add data labels and numbers may not help here, they themselves may become crowded and hard to read.
- As this chart only represents one data set, you need a series to compare multiple sets.
- This may make it more difficult for readers when it comes to analyze and assimilate information quickly.

Example:

The data given below shows the number of hours spent by a school boy on different activities on a working day. Represent the data by a Pie Graph.

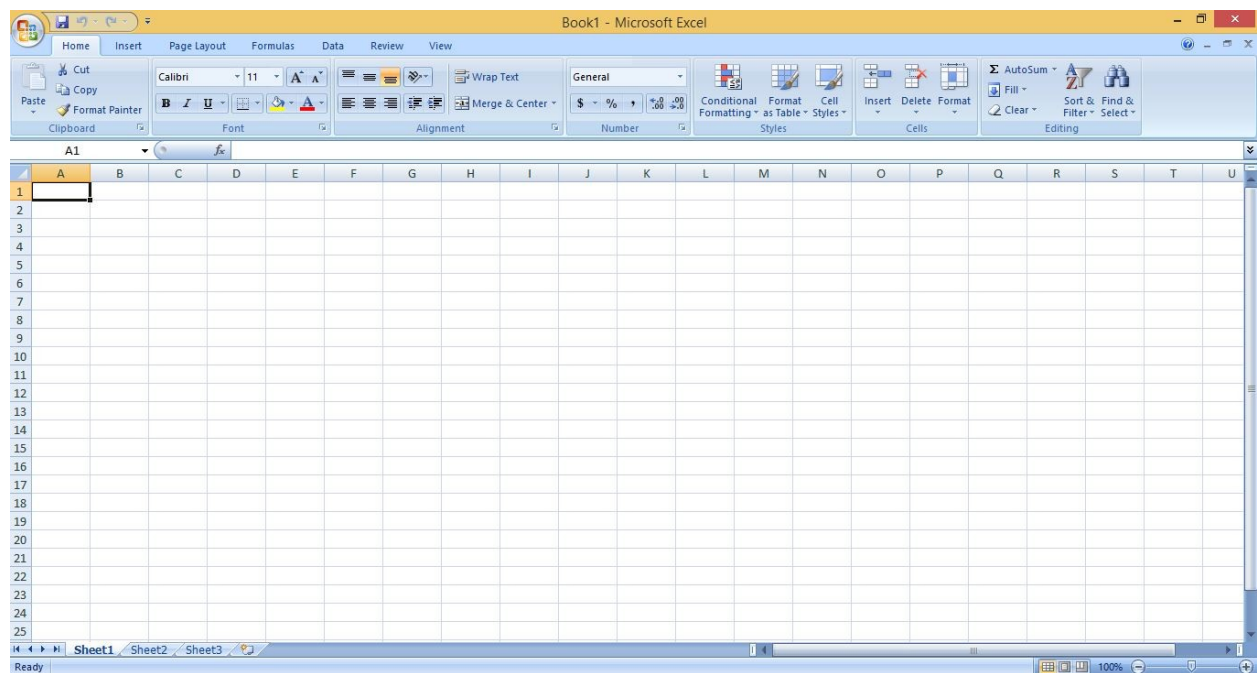
| Activity | School | Homework | Play | Sleep | Other |
|-----------------|--------|----------|------|-------|-------|
| Number of hours | 7 | 4 | 2 | 8 | 3 |

Answer-

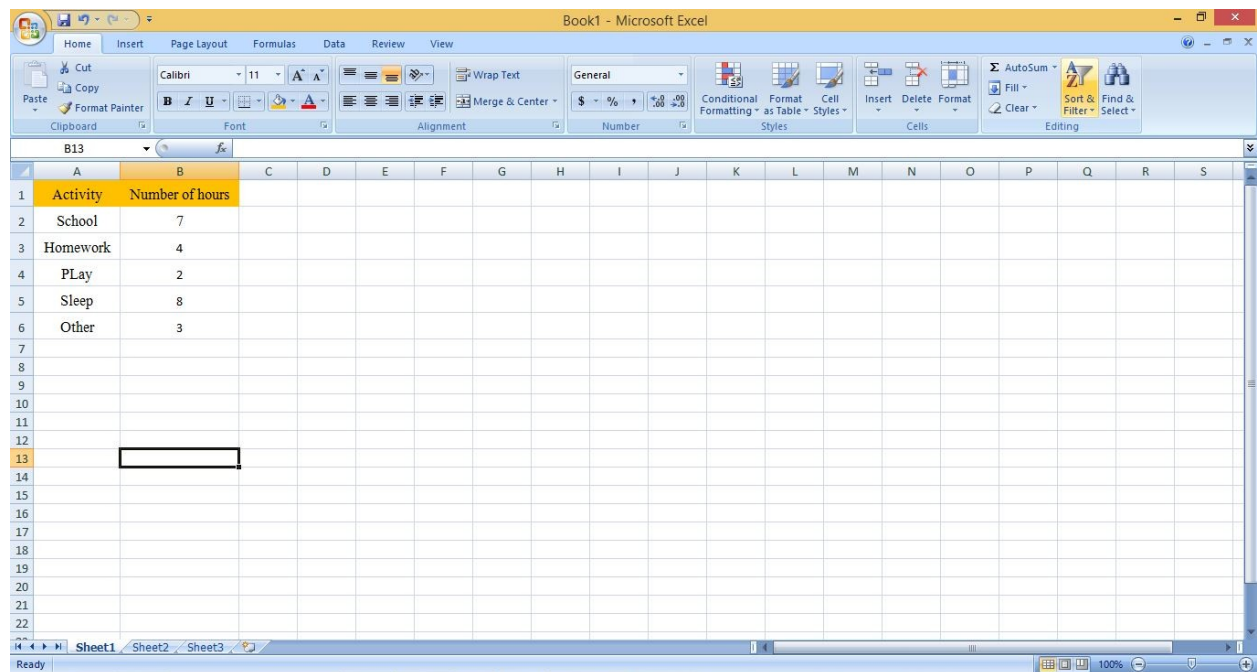


Construction of 'Pie Graph' through MS Excel-

Step 1- Open 'MS Excel' and select 'New Workbook'.

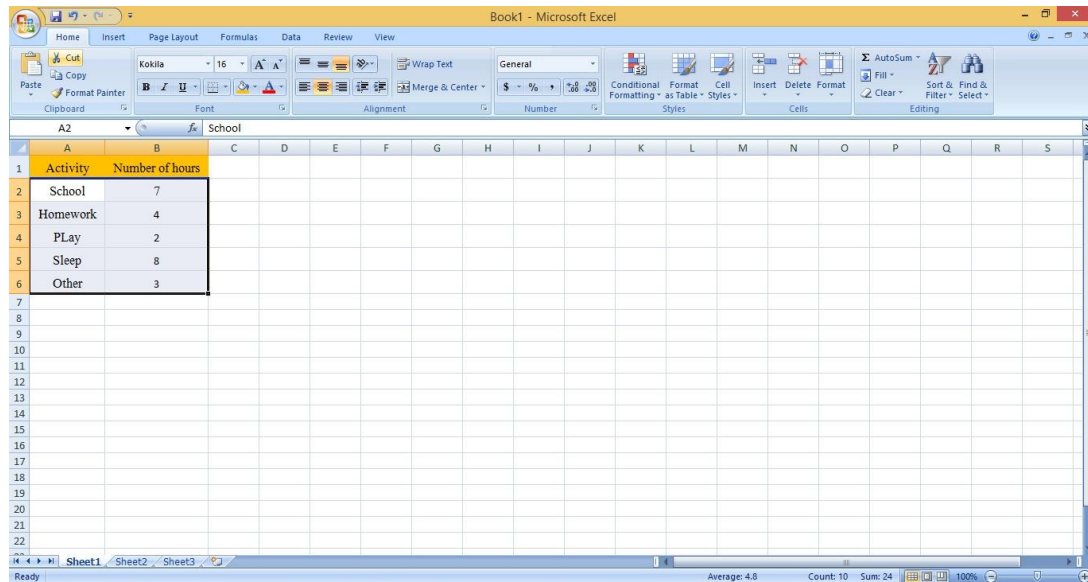


Step 2- Enter the data labels for columns and rows.



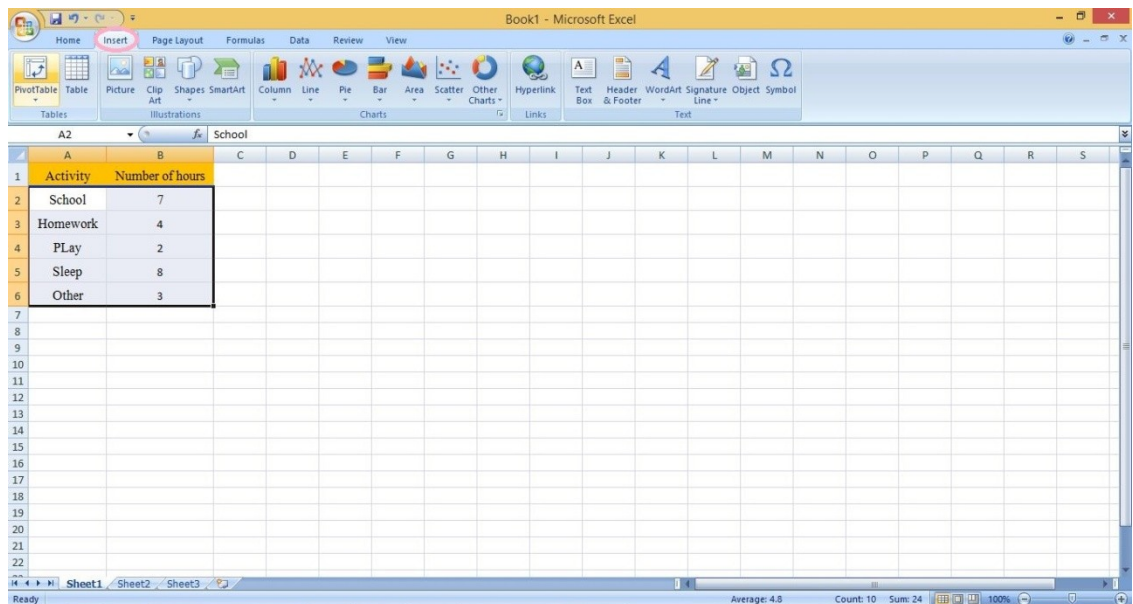
Step 3- Select Range

- i. Highlight the cells that contain the data by clicking and dragging mouse across the cells.
- ii. The cell range will now be highlighted in gray and a chart type can be selected.

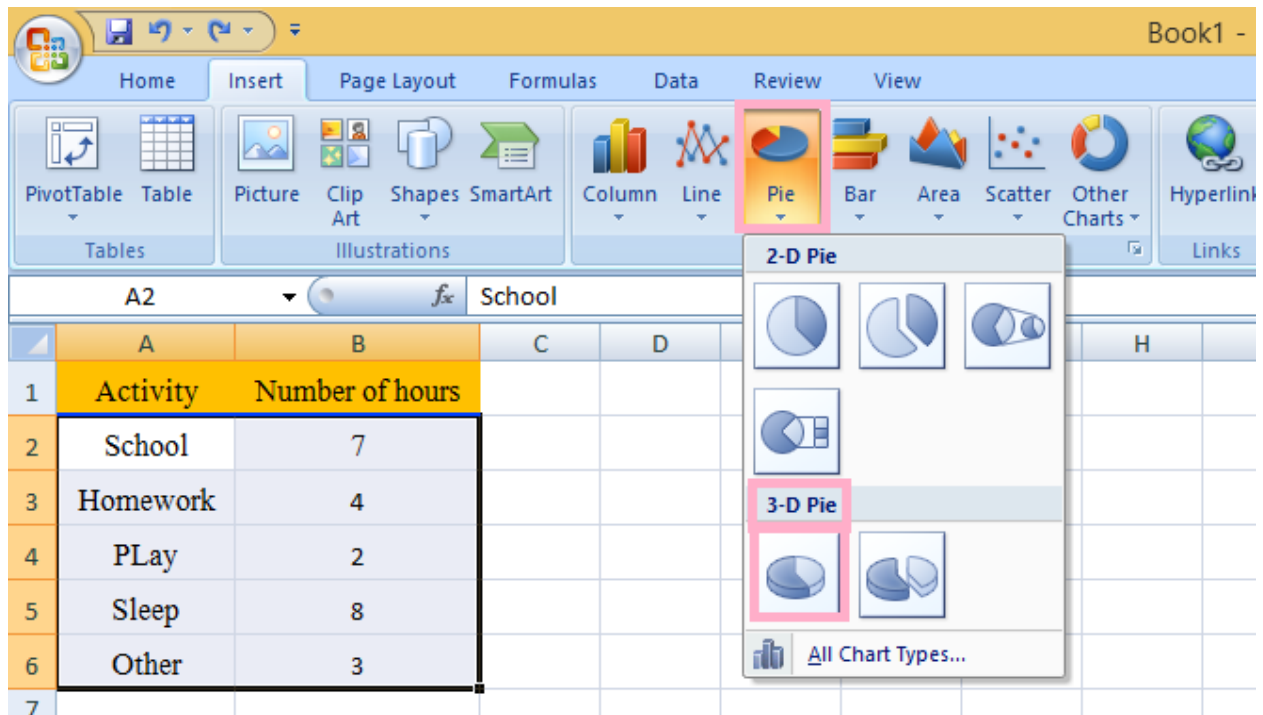


Step 4- Select Chart type

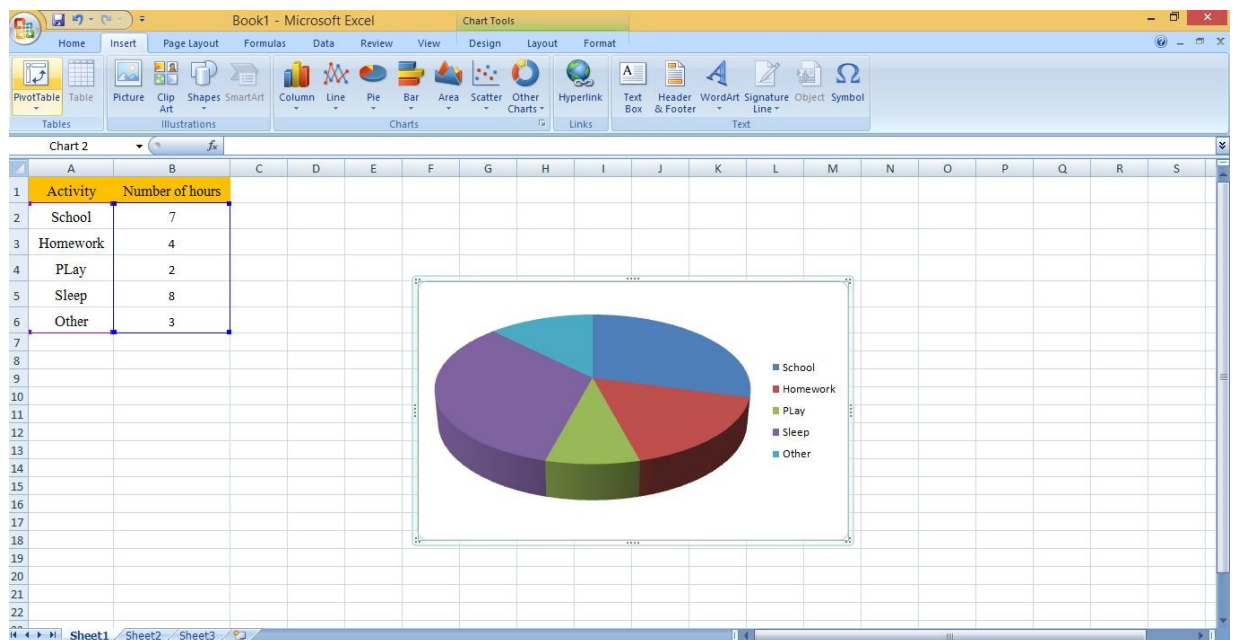
- Click the 'Insert' tab on the top banner. About halfway across the toolbar is a section with several chart options. Excel provides different charts that can be selected by clicking any of the dropdown menus.



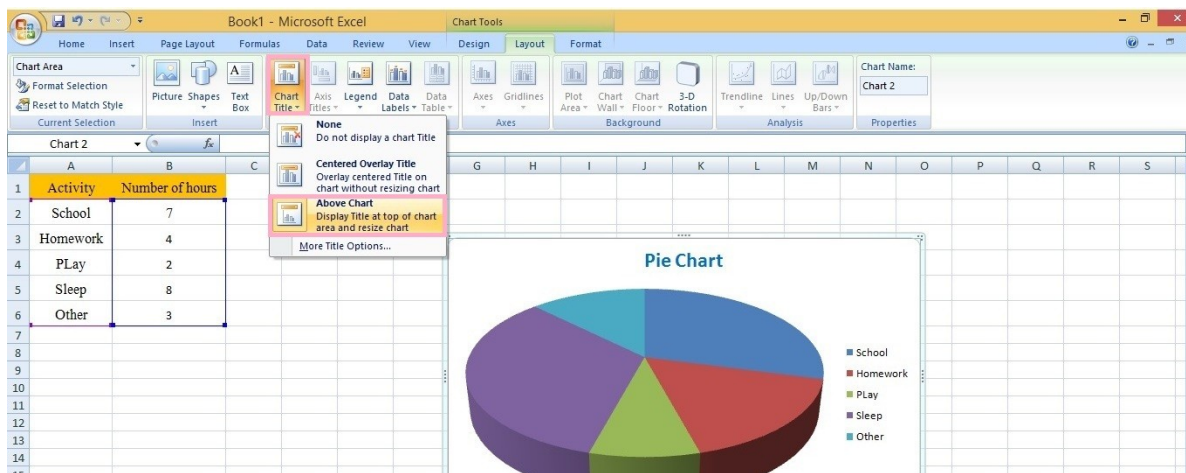
Step 5- Click the ‘Pie Chart’ icon and select ‘3-D Pie.’



- Excel will automatically create a ‘2-D Line Chart’ from the selected data. The chart will appear in the centre of the workbook.

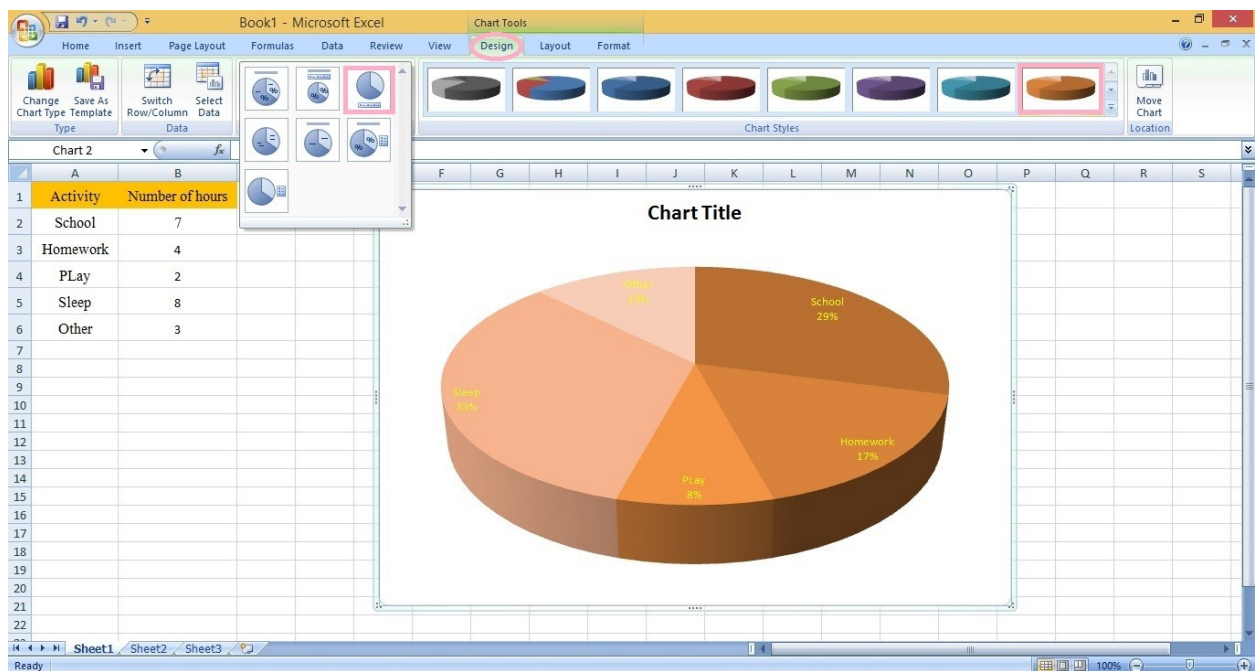


- To name the chart, click on 'Layout' tab and choose the option 'Chart Title' and select the 'Above Chart' from the dropdown menu.



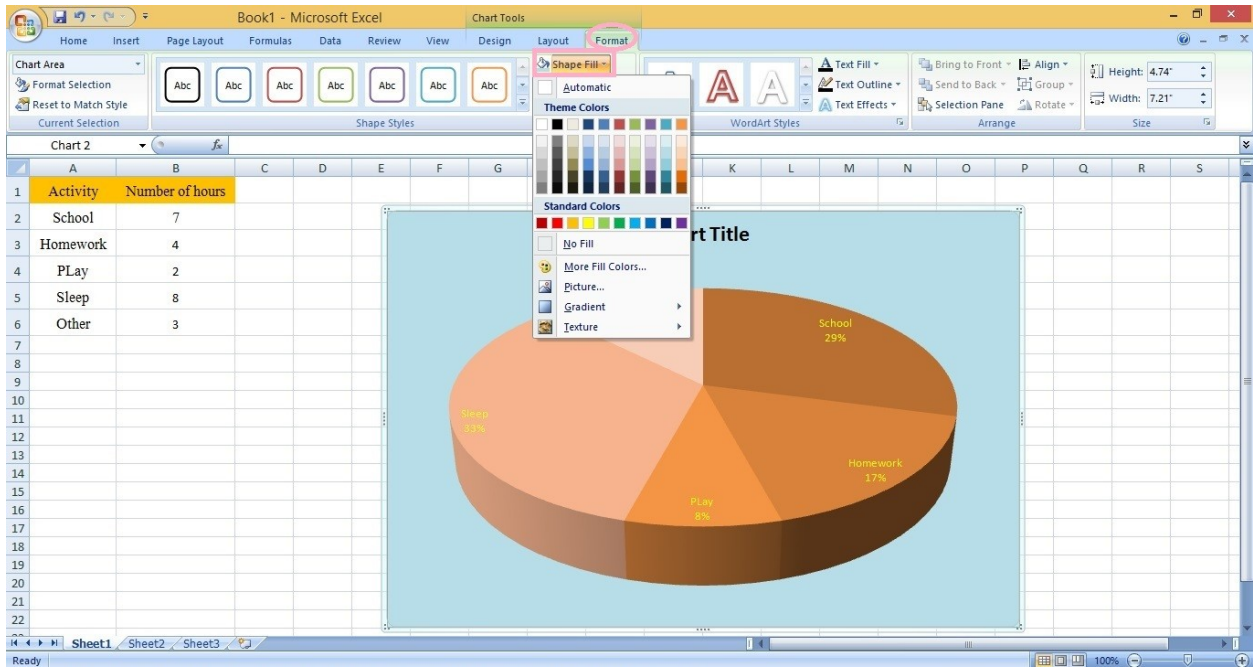
Step 6- Adjust Quick Layout

Click on 'Design' tab to select different layout of graph from the dropdown menu.

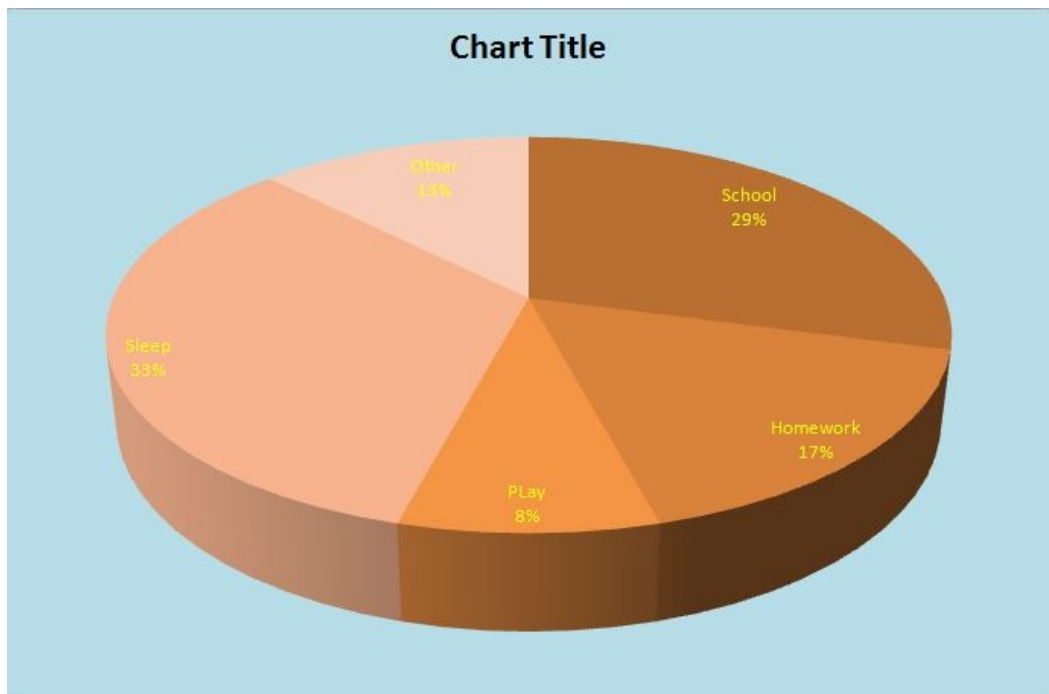


Step 7- Change Formatting

The 'Format' tab allows to change formatting of all elements and text in the chart, including colors, size, shape fill and alignment. Click on 'Format' tab and choose 'Shape Fill' option to format the chart.



Step 8- Final 'Pie Chart'.



Cumulative Frequency Curve-

- ✚ Representation of data in a tabular or graphical form which indicates the frequency (number of times an observation occurs within a particular interval) is known as a frequency distribution of data.
- ✚ In a set of data or observations, cumulative frequency is used to determine the number of observations which lie above a specific observation.
- ✚ To calculate the cumulative frequency for a particular observation, frequency of that observation is added to the sum of frequencies of its predecessors.
- ✚ The last observation's cumulative frequency is the sum of all the frequencies of the entire data set.

Graphical Representation

Representation of cumulative frequency graphically is easy and convenient as compared to representing it using table, bar-graph, frequency polygon etc.

The cumulative frequency graph can be plotted in two ways:

1. Cumulative frequency distribution curve (or ogive) of less than type
2. Cumulative frequency distribution curve (or ogive) of more than type

Cumulative frequency distribution curve (or ogive) of less than type-

To plot the ogive of less than type, a convenient scale is chosen (the scale on both axes may vary). The cumulative frequency curves are created using the cumulative frequencies so, in less than the cumulative frequency curve; the frequencies of all the preceding class or interval are added to the current class or interval frequency. Less than cumulative frequency can be created by adding the frequency of first class to the frequency second-class and so on. The points are then plotted according to given data set and then these points are joined by free hand smooth curve. The curve so obtained gives cumulative frequency distribution graph of less than type.

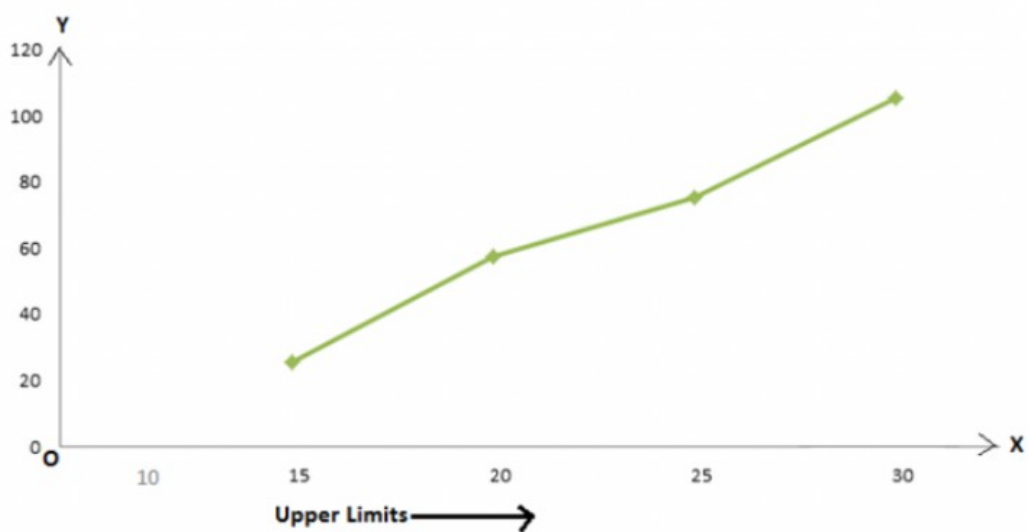
To draw cumulative frequency distribution graph of less than type, consider the following cumulative frequency distribution table which gives the number of participants in any level of essay writing competition according to their age:

Table 1 Cumulative Frequency distribution table of less than type

| Level of Essay | Age Group (class interval) | Age group | Less than | Number of participants (Frequency) | Cumulative Frequency |
|----------------|----------------------------|--------------|-----------|------------------------------------|----------------------|
| Level 1 | 10-15 | Less than 15 | | 20 | 20 |
| Level 2 | 15-20 | Less than 20 | | 32 | 52 |
| Level 3 | 20-25 | Less than 25 | | 18 | 70 |
| Level 4 | 25-30 | Less than 30 | | 30 | 100 |

On plotting corresponding points according to table 1, we have

Graph 1: Cumulative Frequency Graph of less than type



Cumulative frequency distribution curve (or ogive) of more than type-

To plot the ogive of more than type, a convenient scale is chosen which may be varying on both the axes. The cumulative frequency curves are created using the cumulative frequencies so, in more than cumulative frequency curve; the frequencies of succeeding class or interval are added to the current class or interval frequency. More than cumulative frequency can be created by subtracting the frequency of the second-class from the first class and so on. The points are then plotted according to given data set and then these points are joined by free hand smooth curve. The curve so obtained gives cumulative frequency distribution graph of more than type.

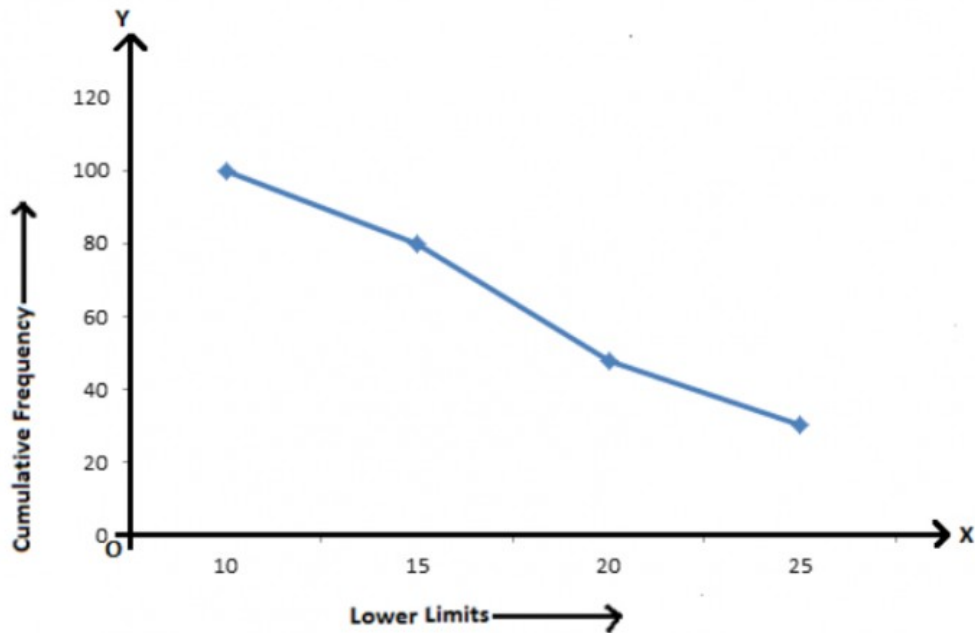
To draw cumulative frequency distribution graph of more than type, consider the same cumulative frequency distribution table, which gives the number of participants in any level of essay writing competition according to their age:

Table 1 Cumulative Frequency distribution table of more than type

| Level of Essay | Age Group (class interval) | Age group | Number of participants (Frequency) | Cumulative Frequency |
|----------------|-------------------------------|--------------|---------------------------------------|----------------------|
| Level 1 | 10-30 | More than 10 | 20 | 100 |
| Level 2 | 15-30 | More than 15 | 32 | 80 |
| Level 3 | 20-30 | More than 20 | 18 | 48 |
| Level 4 | 25-30 | More than 25 | 30 | 30 |

On plotting these points, we get a curve as shown in the graph 2.

Graph 2: Cumulative Frequency Graph of more than type



These graphs are helpful in figuring out the median of a given data set. The median can be found out by drawing both types of cumulative frequency distribution curves on the same graph. The value of the point of intersection of both the curves gives the median of the given set of data. For the given table 1, the median can be calculated as shown:

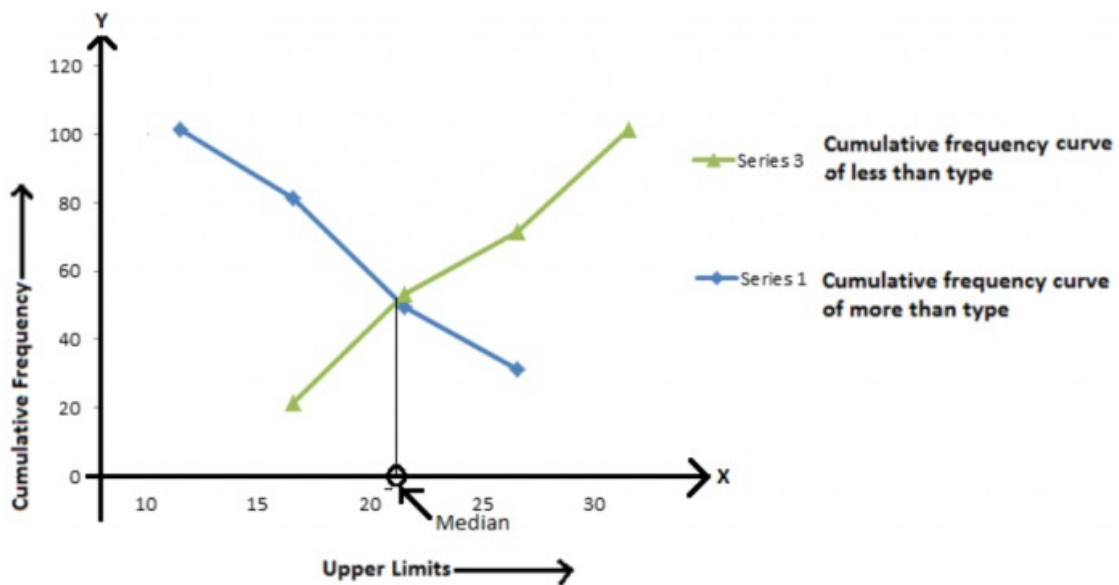


Figure 1 Median using cumulative frequency graph

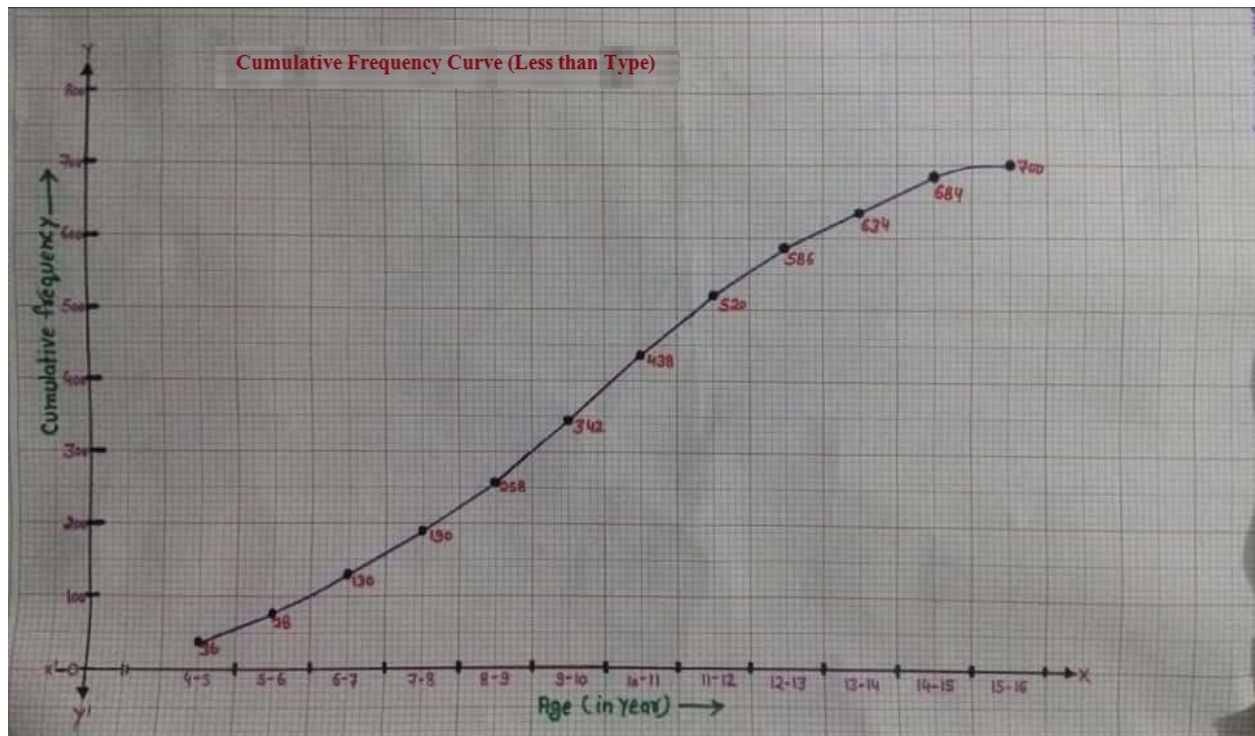
Example 1-

Following is the age distribution of group students. Now, draw the cumulative frequency curve of less than type.

| Age (in years) | 4-5 | 5-6 | 6-7 | 7-8 | 8-9 | 9-10 | 10-11 | 11-12 | 12-13 | 13-14 | 14-15 | 15-16 |
|----------------|-----|-----|-----|-----|-----|------|-------|-------|-------|-------|-------|-------|
| Frequency | 36 | 42 | 52 | 60 | 68 | 84 | 96 | 82 | 66 | 48 | 50 | 16 |

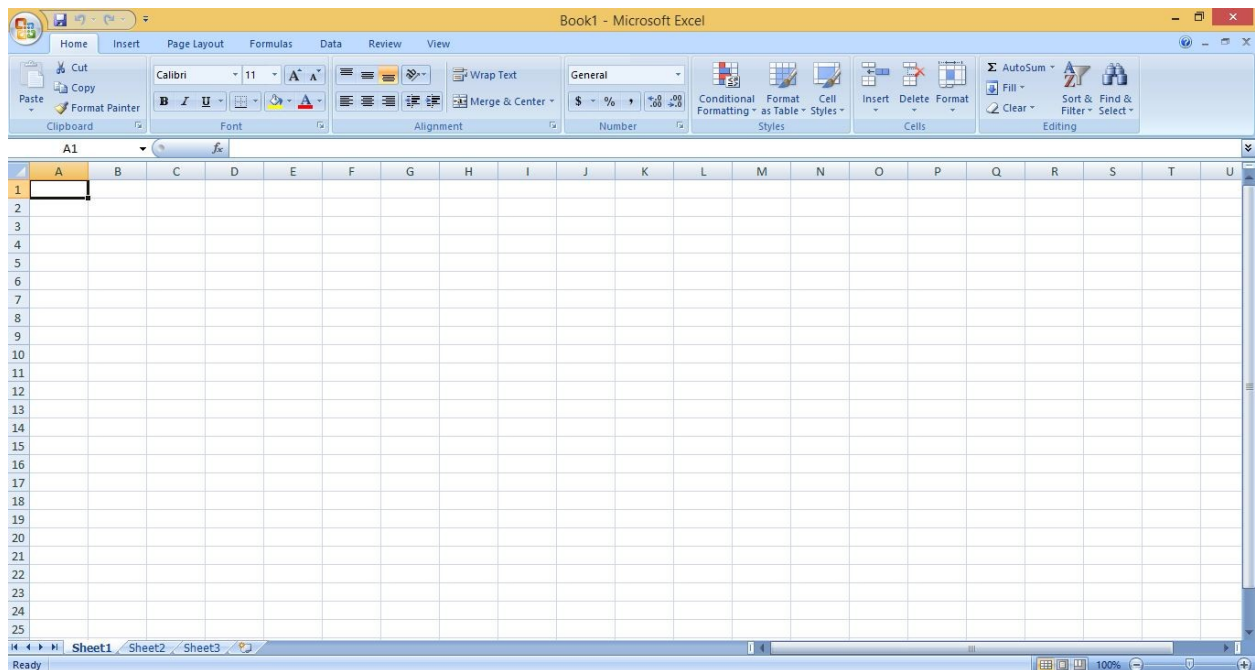
Answer-

| Age (in years) | Frequency | Cumulative frequency curve (Less Than) |
|----------------|-----------|--|
| 4-5 | 36 | 36 |
| 5-6 | 42 | 78 |
| 6-7 | 52 | 130 |
| 7-8 | 60 | 190 |
| 8-9 | 68 | 258 |
| 9-10 | 84 | 342 |
| 10-11 | 96 | 438 |
| 11-12 | 82 | 520 |
| 12-13 | 66 | 586 |
| 13-14 | 48 | 634 |
| 14-15 | 50 | 684 |
| 15-16 | 16 | 700 |



Construction of 'Cumulative Frequency Curve (Less than Type)' through MS Excel-

Step 1- Open 'MS Excel' and select 'New Workbook'.



Step 2- Enter the data labels for columns and rows.

The screenshot shows an Excel spreadsheet with the following data:

| Age in (years) | Frequency | Cumulative Frequency (Less than) |
|----------------|-----------|----------------------------------|
| 4-5 | 36 | 36 |
| 5-6 | 42 | 78 |
| 6-7 | 52 | 130 |
| 7-8 | 60 | 190 |
| 8-9 | 68 | 258 |
| 9-10 | 84 | 342 |
| 10-11 | 96 | 438 |
| 11-12 | 82 | 520 |
| 12-13 | 66 | 586 |
| 13-14 | 48 | 634 |
| 14-15 | 50 | 684 |
| 15-16 | 16 | 700 |

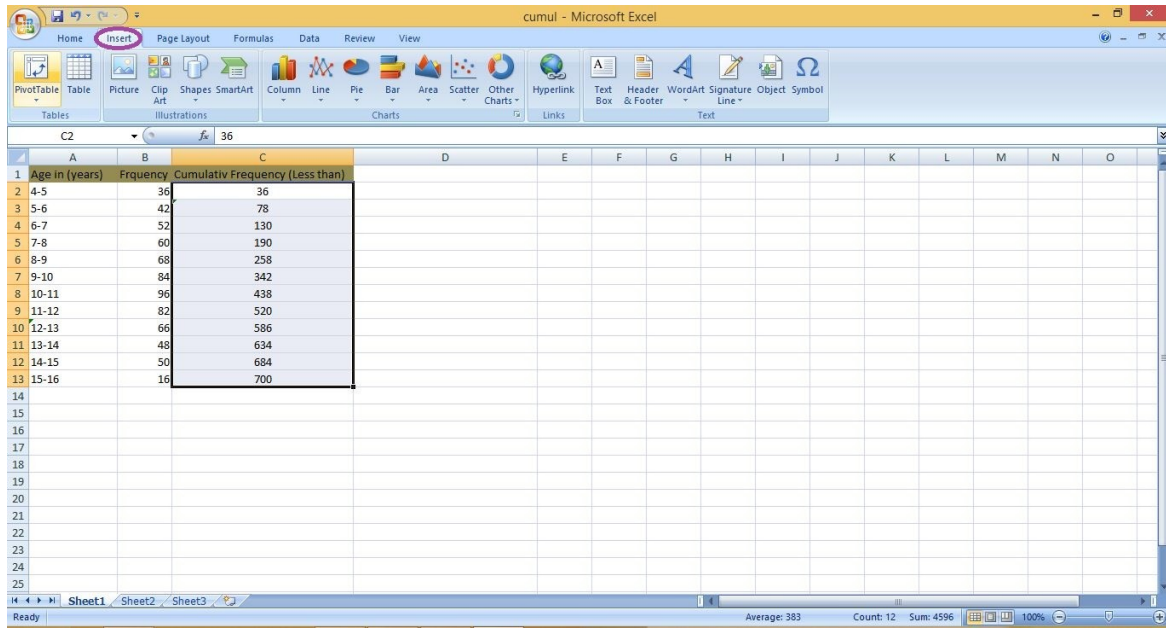
Step 3- Select Range

- Highlight the cells that contain the data by clicking and dragging mouse across the cells.
- The cell range will now be highlighted in gray and a chart type can be selected.

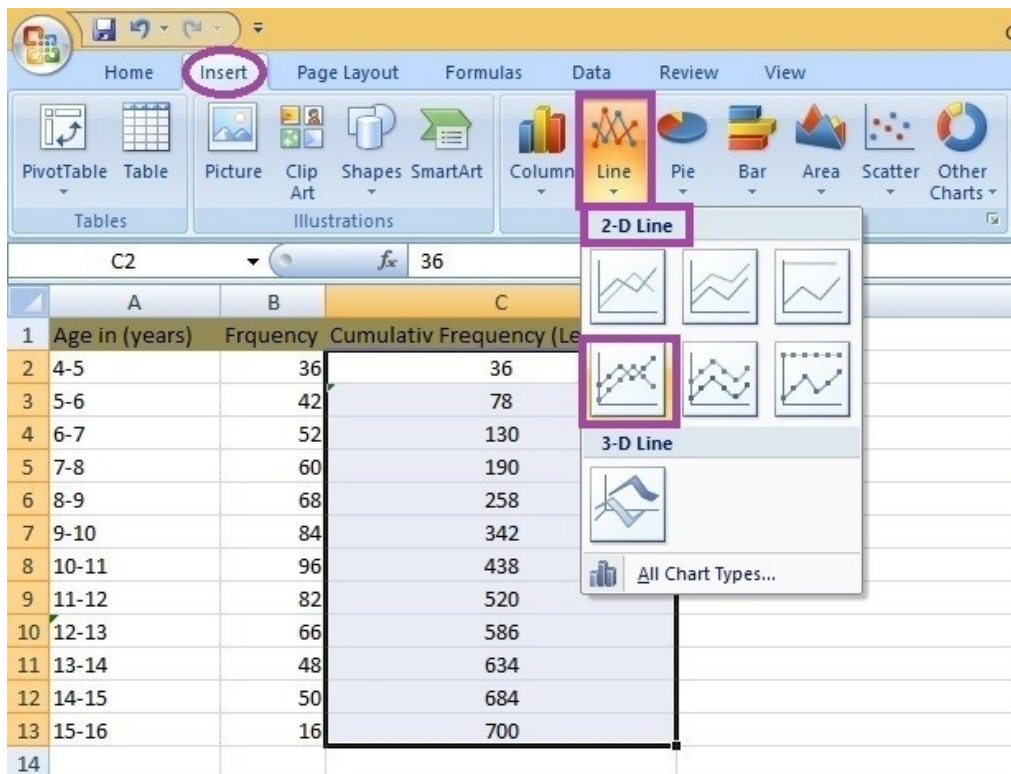
The screenshot shows the same Excel spreadsheet as before, but the data range (B2:C13) is now highlighted in gray. The status bar at the bottom indicates: Average: 383, Count: 12, Sum: 4596.

Step 4- Select Chart type

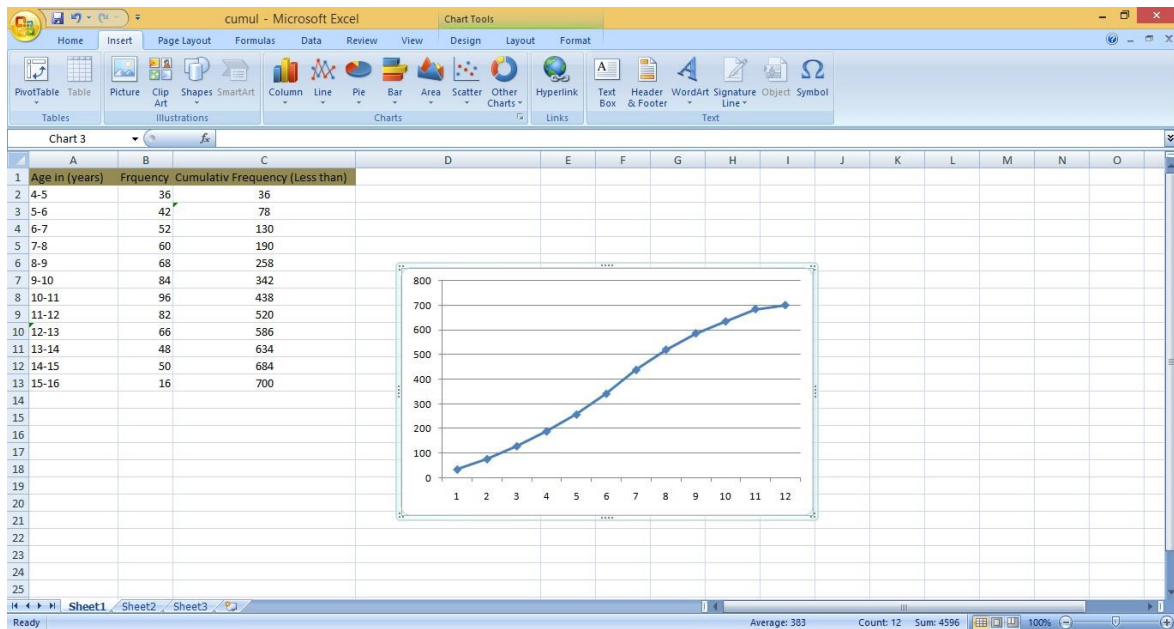
- Click the 'Insert' tab on the top banner. About halfway across the toolbar is a section with several chart options. Excel provides different charts that can be selected by clicking any of the dropdown menus.



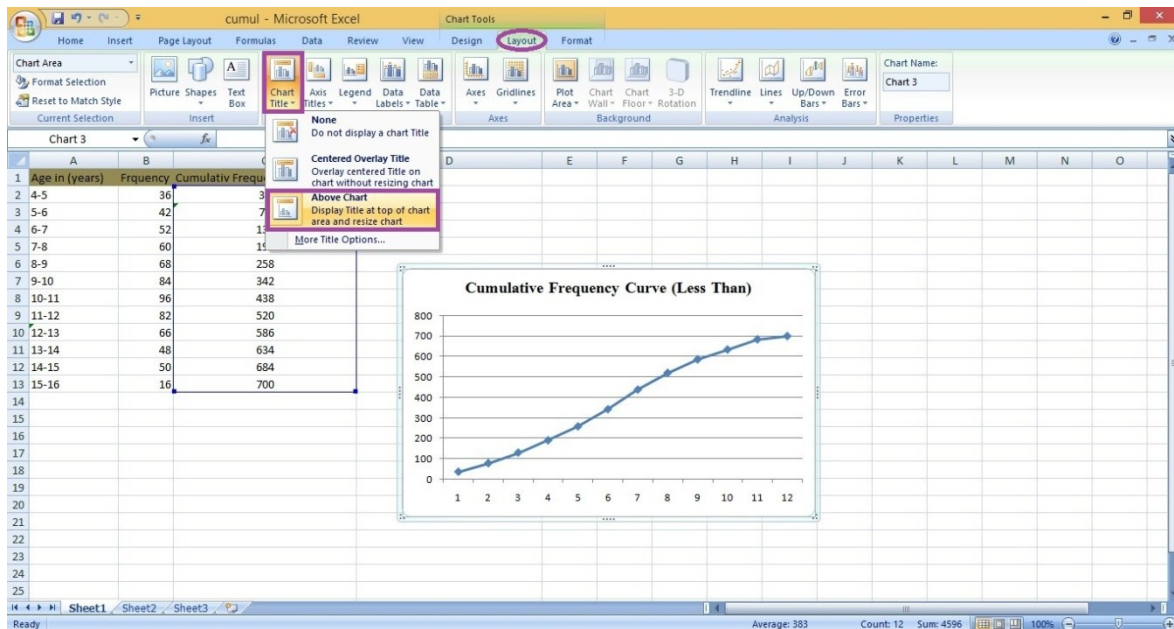
Step 5- Click the 'Line Chart' icon and select '2-D Line.'



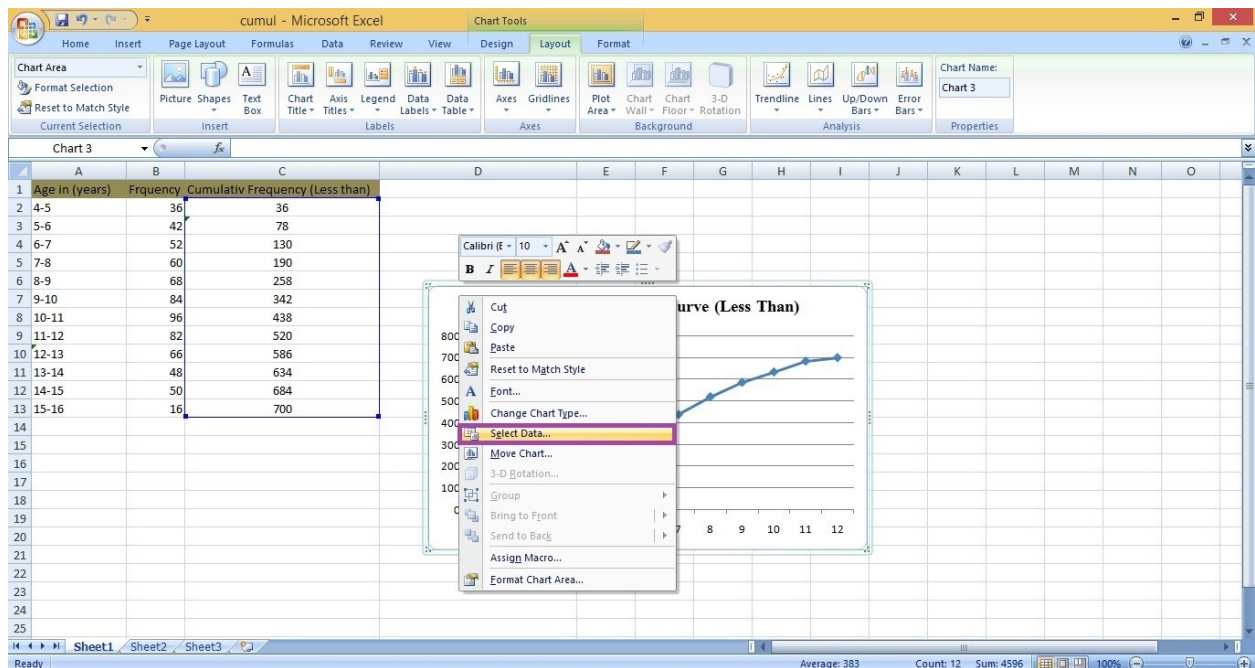
- Excel will automatically create a '2-D Line Chart' from the selected data. The chart will appear in the centre of the workbook.



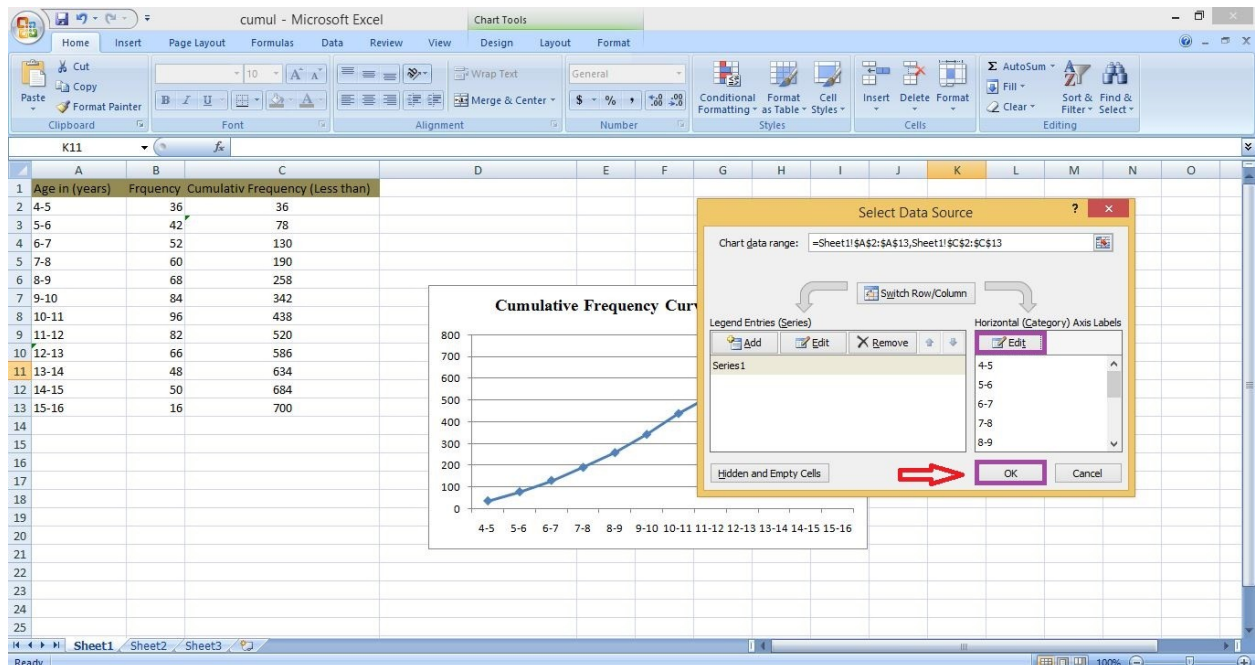
- To name the chart, click on 'Layout' tab and choose the option 'Chart Title' and select the 'Above Chart' from the dropdown menu.



Step 6- Right click the mouse on the inserted graph and choose the option ‘Select Data’.



- Click on ‘Edit’ to fill the horizontal axis data.

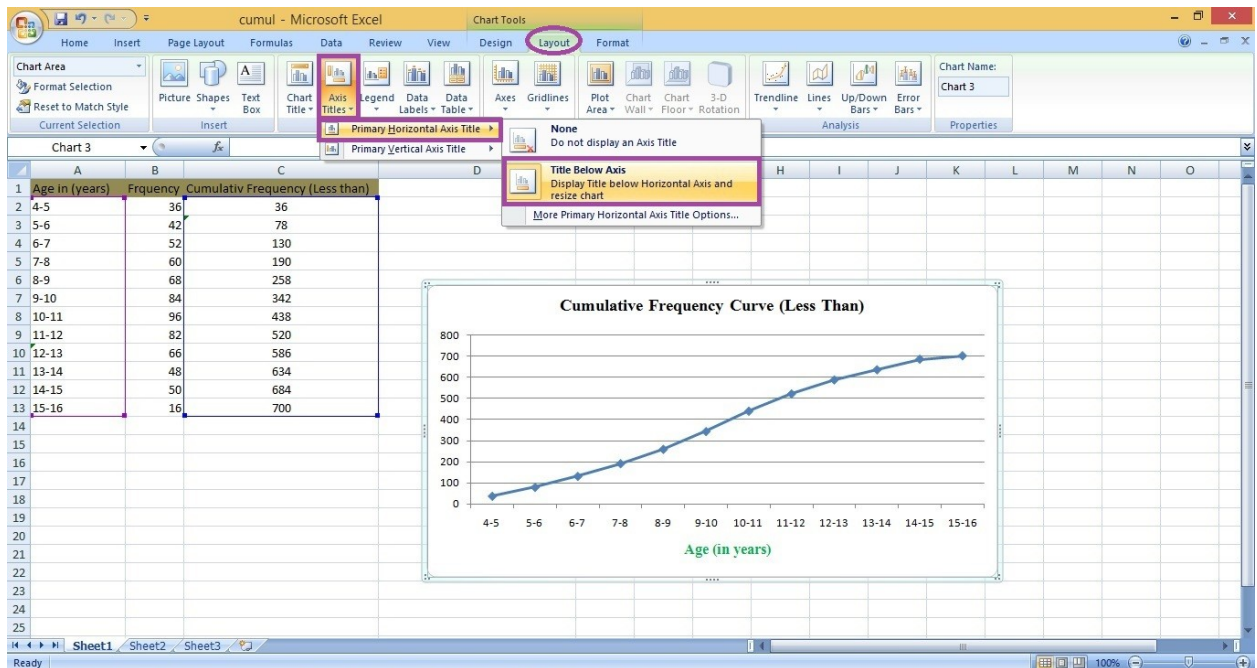


Step 7- Add Chart Elements

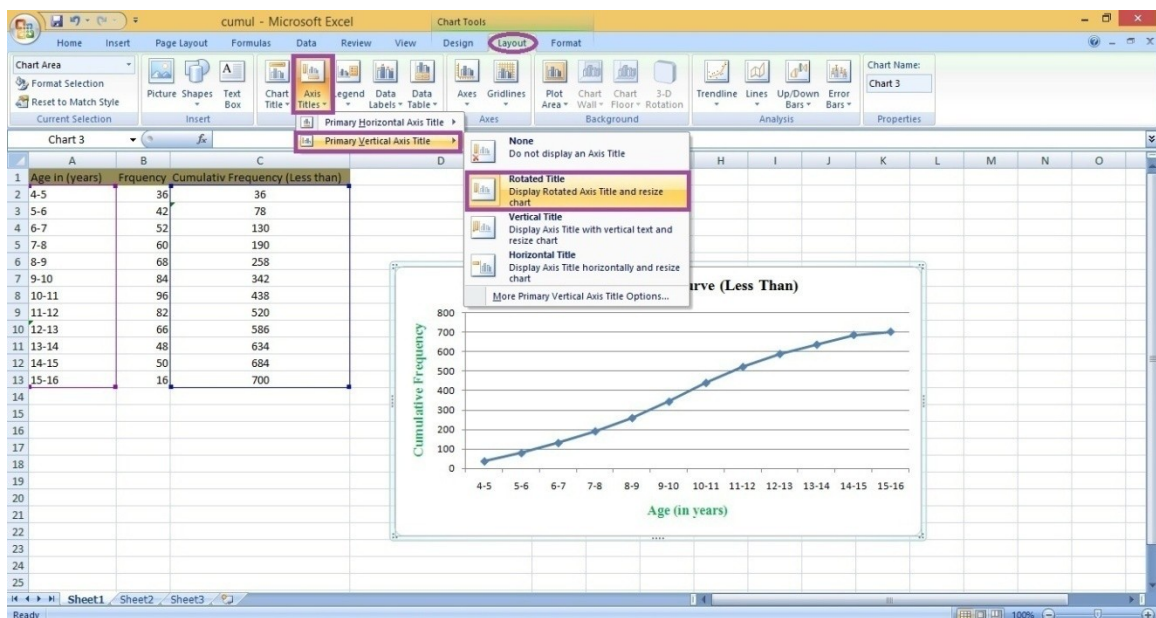
Adding chart elements to the chart or graph will enhance it by clarifying data or providing additional context.

❖ To Add Axis Title:

- i. To create horizontal axis title, click on 'Layout' tab and choose the option 'Axis Title.' Select the 'Primary Horizontal Axis Title' and 'Title Below Axis' respectively from the dropdown menu. A text box will appear on the chart.

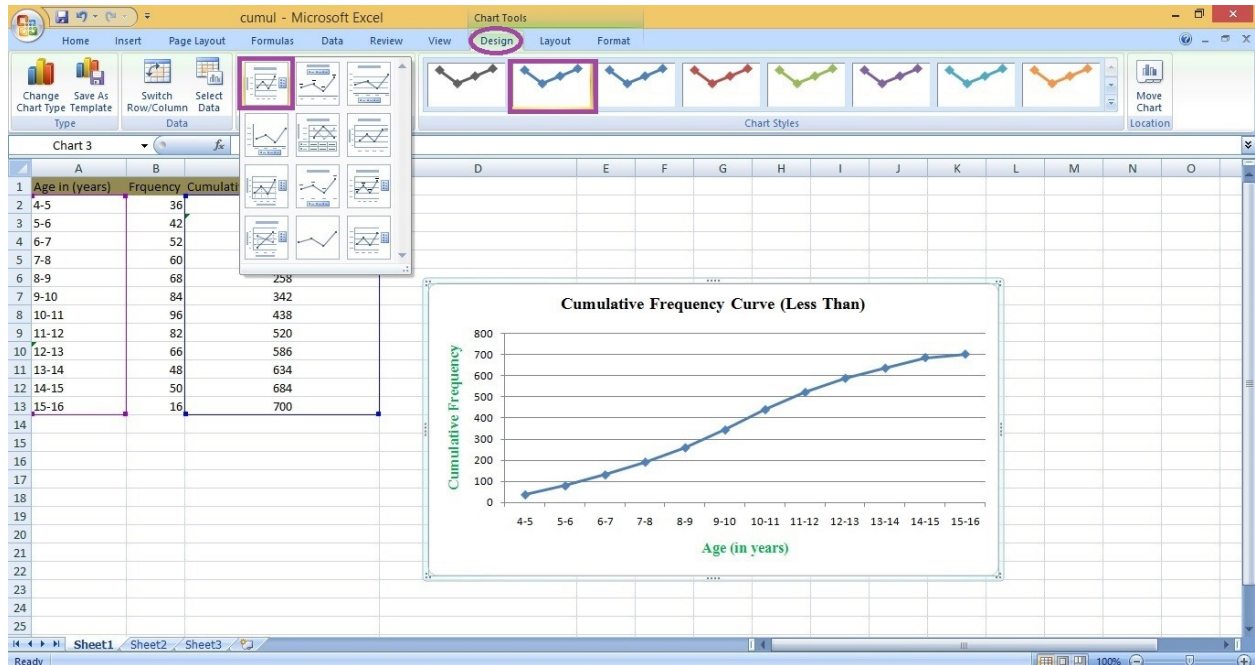


- ii. To create vertical axis title, click on 'Layout' tab and choose the option 'Axis Title.' Select the 'Primary Vertical Axis Title' and 'Rotated Title' respectively from the dropdown menu. A text box will appear on the chart.



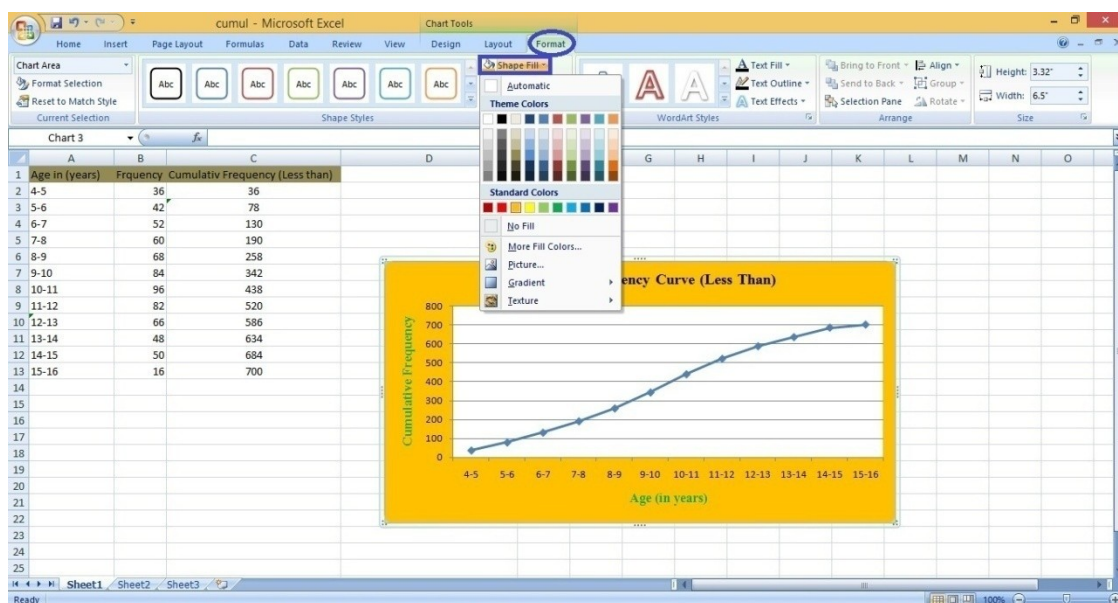
Step 8- Adjust Quick Layout

Click on 'Design' tab to select different layout of graph from the dropdown menu.



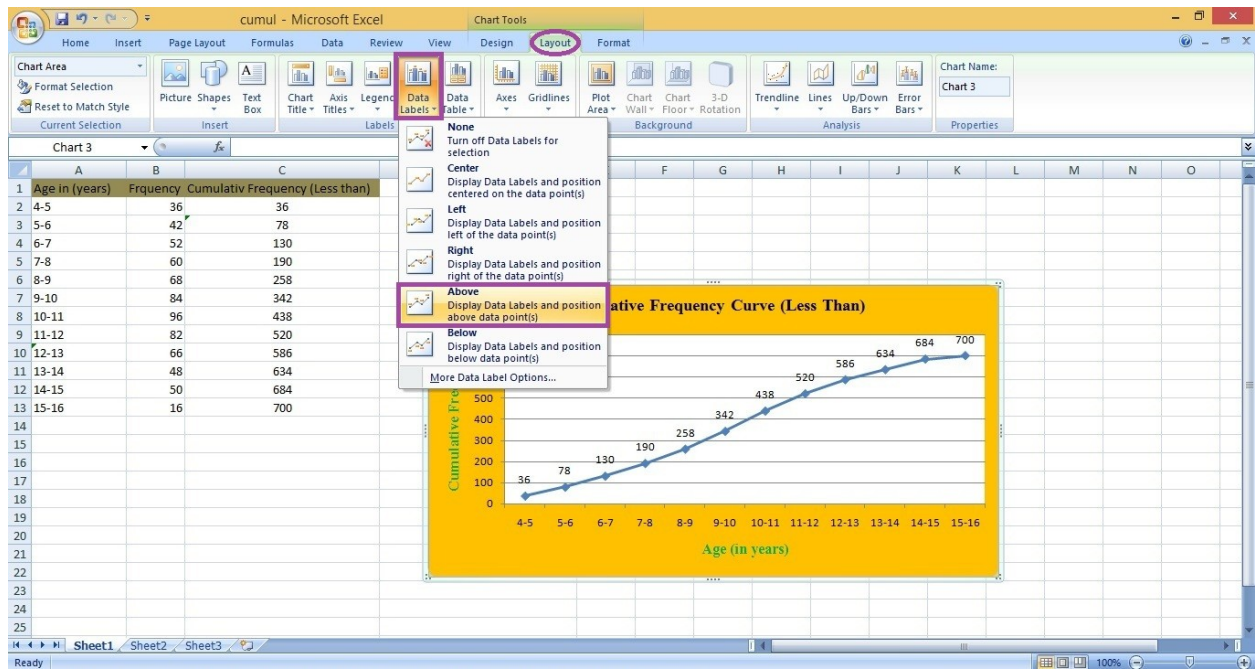
Step 9- Change Formatting

The 'Format' tab allows to change formatting of all elements and text in the chart, including colors, size, shape fill and alignment. Click on 'Format' tab and choose 'Shape Fill' option to format the chart.

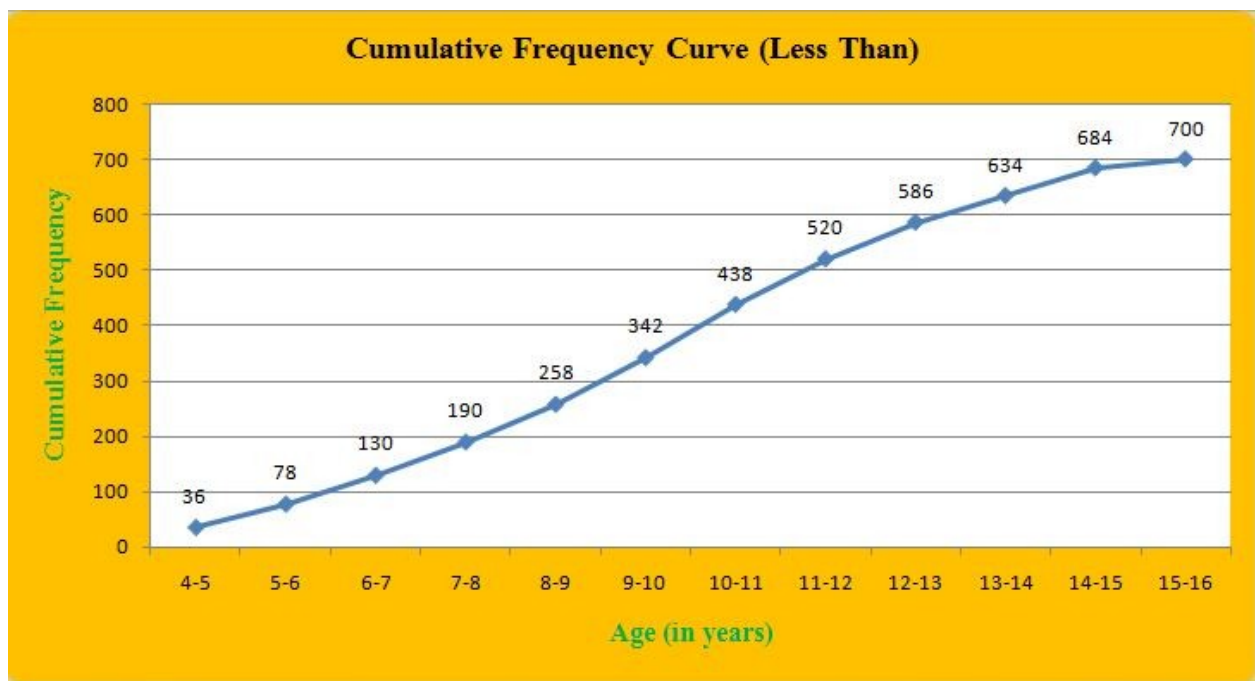


Step 10- To Add Data Labels:

Click on 'Layout' tab and click on 'Data Label.' There are seven options for data labels: None (default), Centre, Left, Right, Above, Below, and More Data label Title Options. Select anyone of them according to choice.



Step 11- Final 'Cumulative Frequency Curve (Less Than)'.



Example 2-

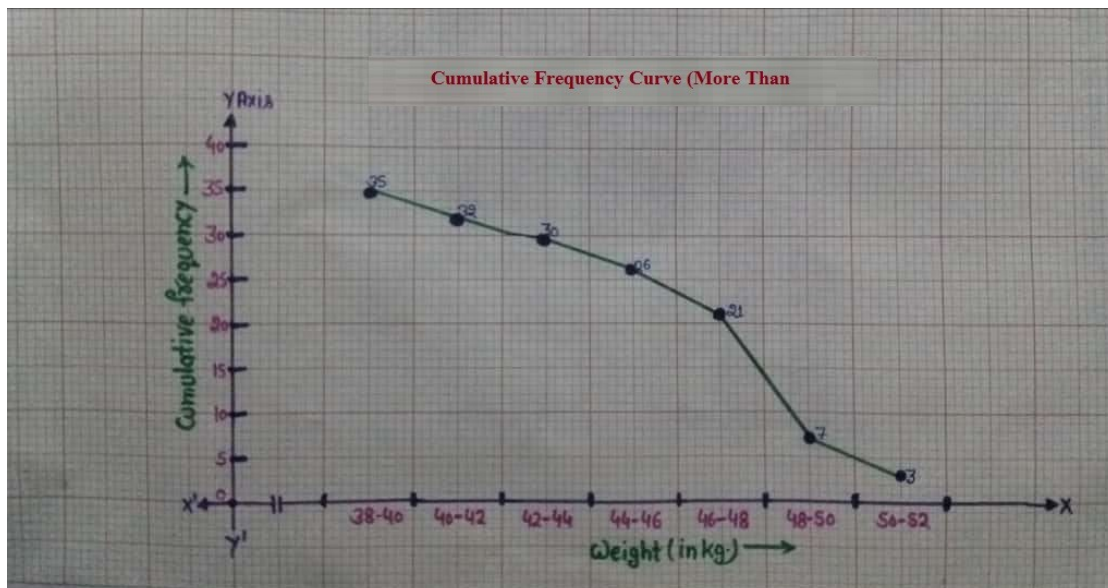
During the medical check-up of 35 students of a college their weight were recorded as follows:

| Weight (in kg) | 38-40 | 40-42 | 42-44 | 44-46 | 46-48 | 48-50 | 50-52 |
|--------------------|-------|-------|-------|-------|-------|-------|-------|
| Number of students | 3 | 2 | 4 | 5 | 14 | 4 | 3 |

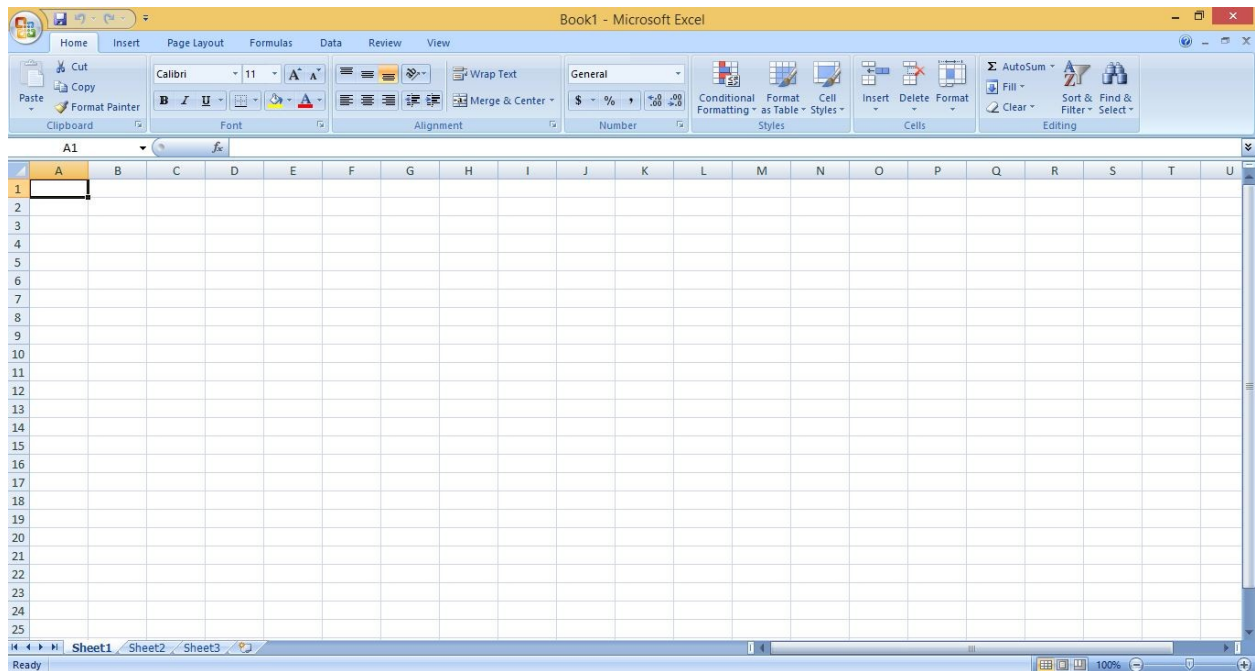
Draw a more than type cumulative frequency curve from the given data.

Answer-

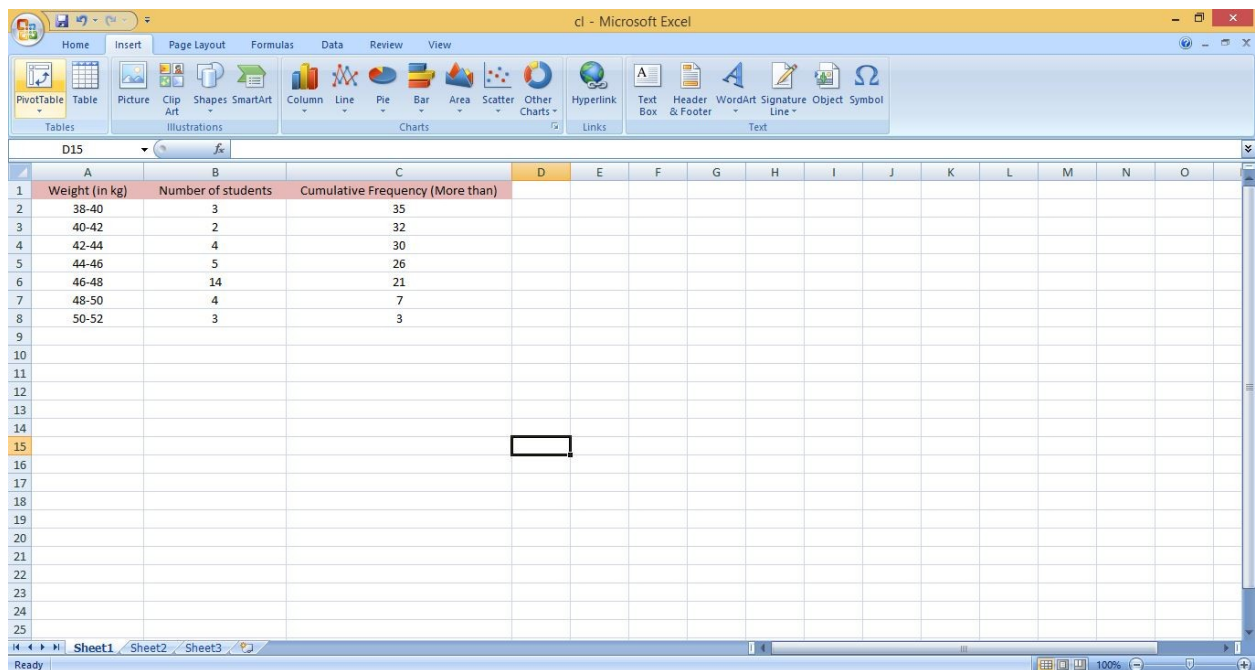
| Weight (in kg) | Number of students | Cumulative Frequency (More than) |
|----------------|--------------------|----------------------------------|
| 38-40 | 3 | 35 |
| 40-42 | 2 | 32 |
| 42-44 | 4 | 30 |
| 44-46 | 5 | 26 |
| 46-48 | 14 | 21 |
| 48-50 | 4 | 7 |
| 50-52 | 3 | 3 |



Step 1- Open 'MS Excel' and select 'New Workbook'.



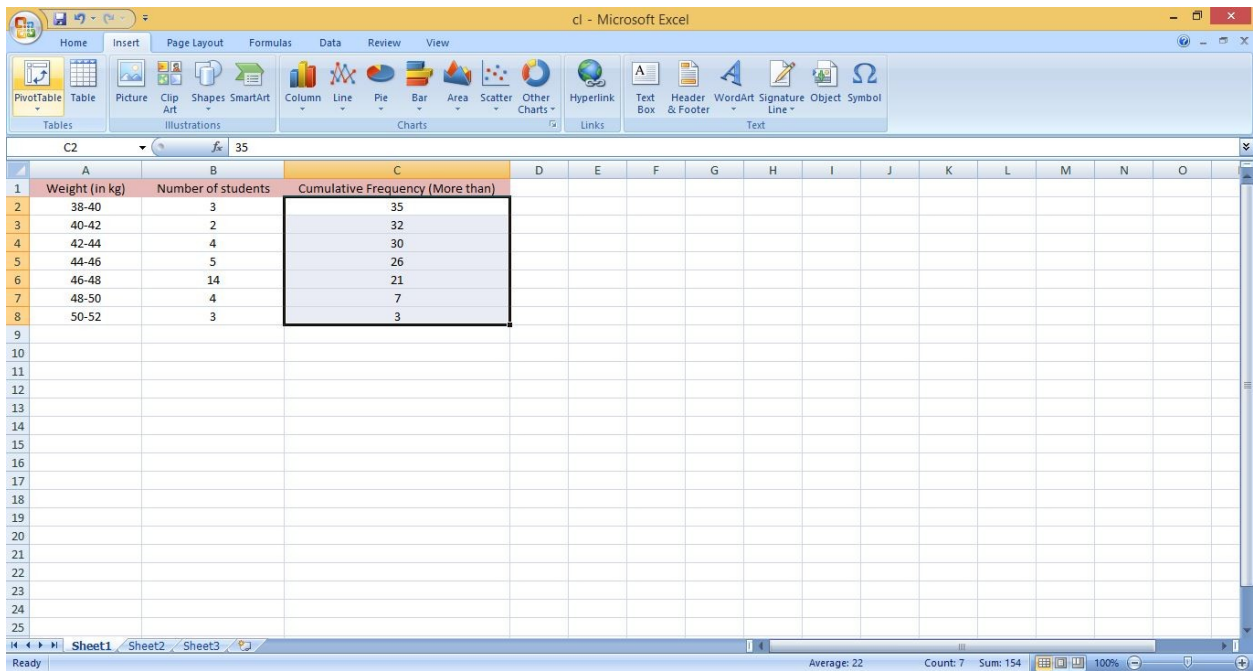
Step 2- Enter the data labels for columns and rows.



Step 3- Select Range

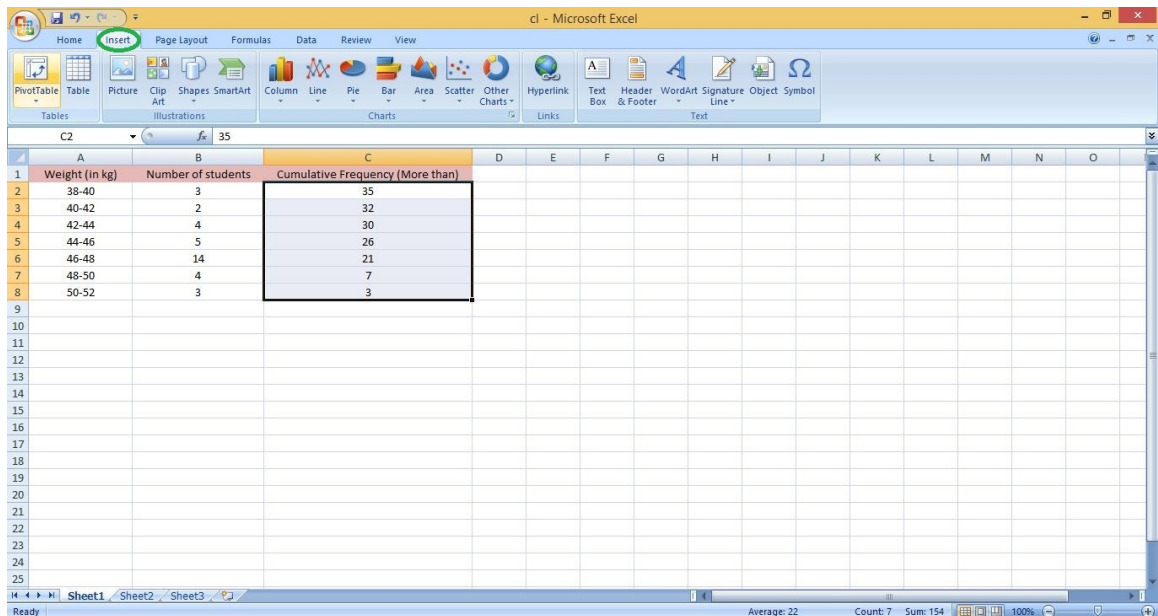
1. Highlight the cells that contain the data by clicking and dragging mouse across the cells.

2. The cell range will now be highlighted in gray and a chart type can be selected.

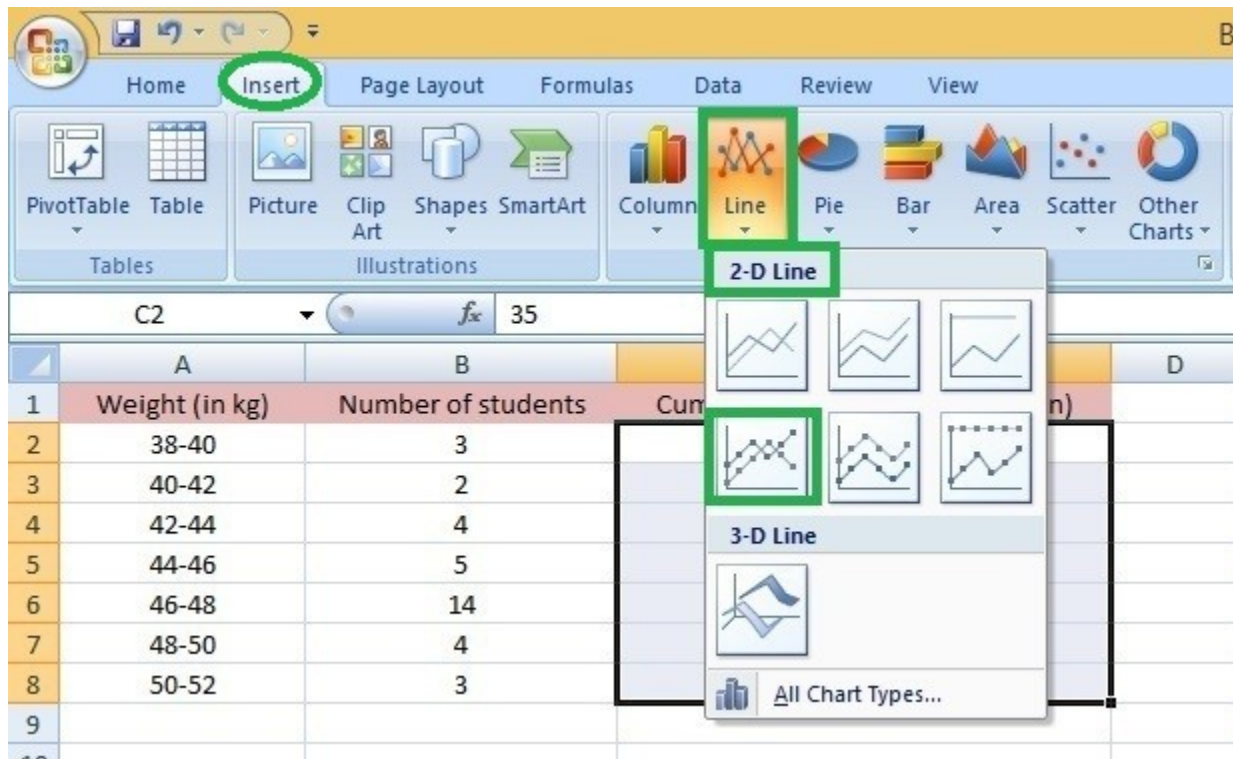


Step 4- Select Chart type

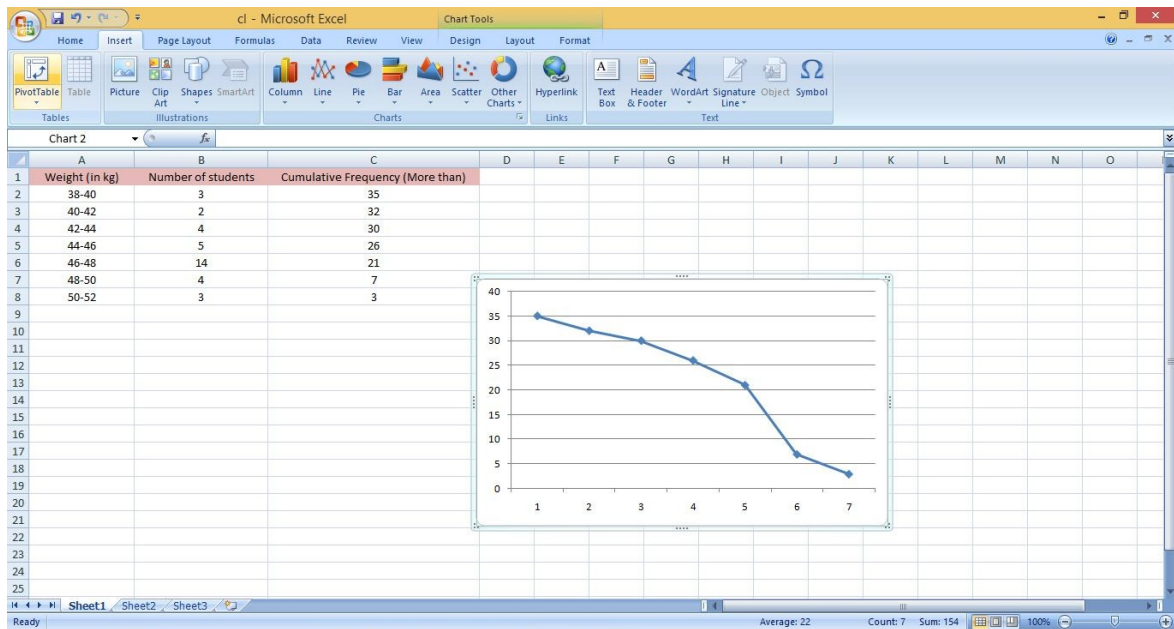
- Click the 'Insert' tab on the top banner. About halfway across the toolbar is a section with several chart options. Excel provides different charts that can be selected by clicking any of the dropdown menus.



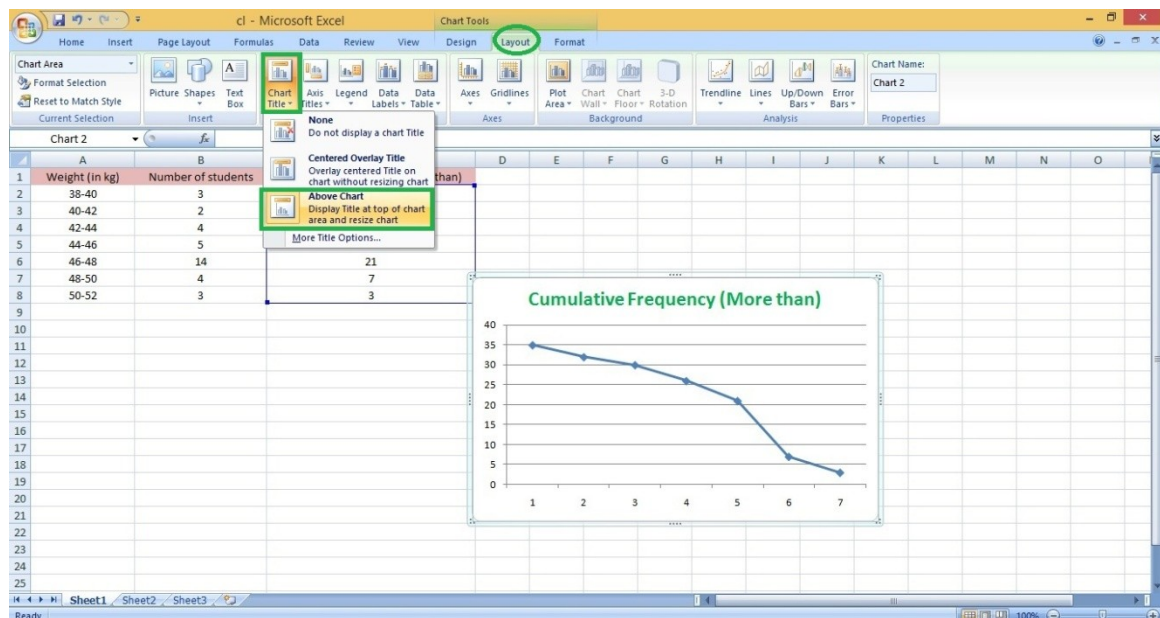
Step 5- Click the 'Line Chart' icon and select '2-D Line.'



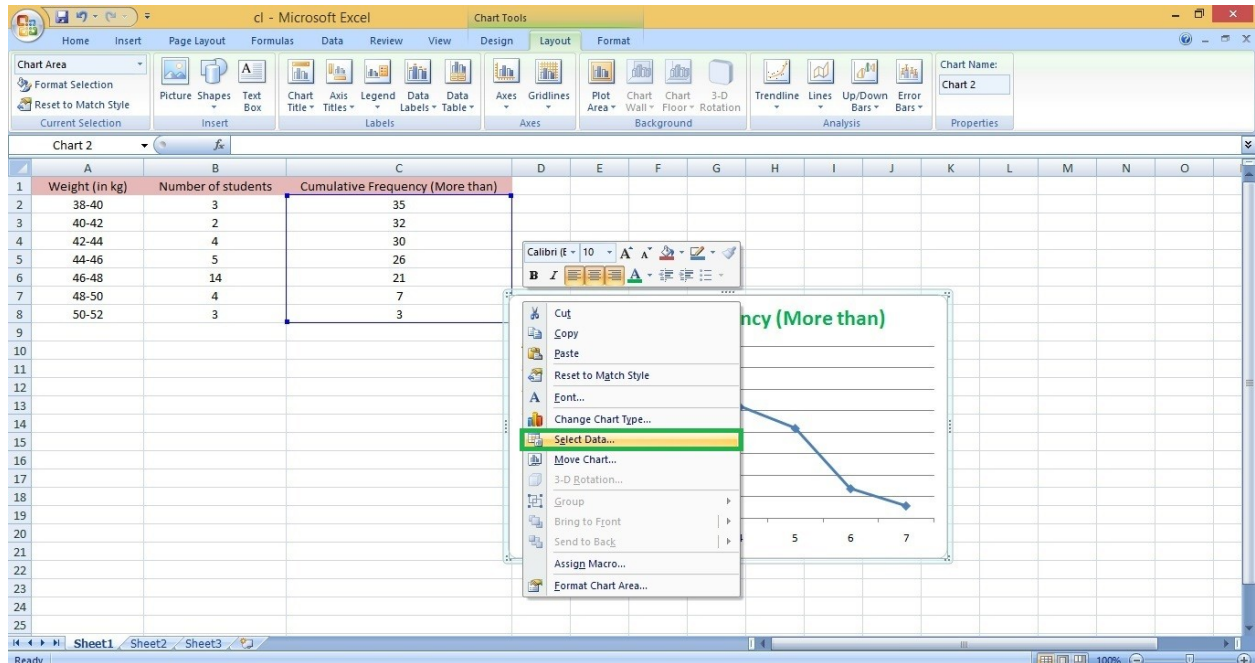
- Excel will automatically create a '2-D Line Chart' from the selected data. The chart will appear in the centre of the workbook.



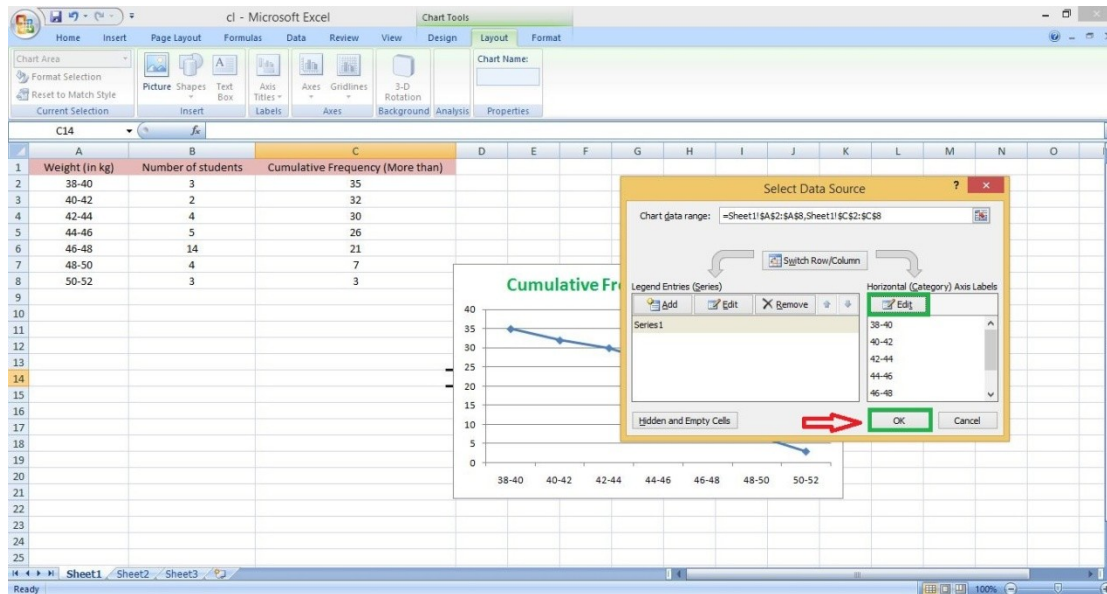
- To name the chart, click on 'Layout' tab and choose the option 'Chart Title' and select the 'Above Chart' from the dropdown menu.



Step 6- Right click the mouse on the inserted graph and choose the option 'Select Data'.



- Click on 'Edit' to fill the horizontal axis data.

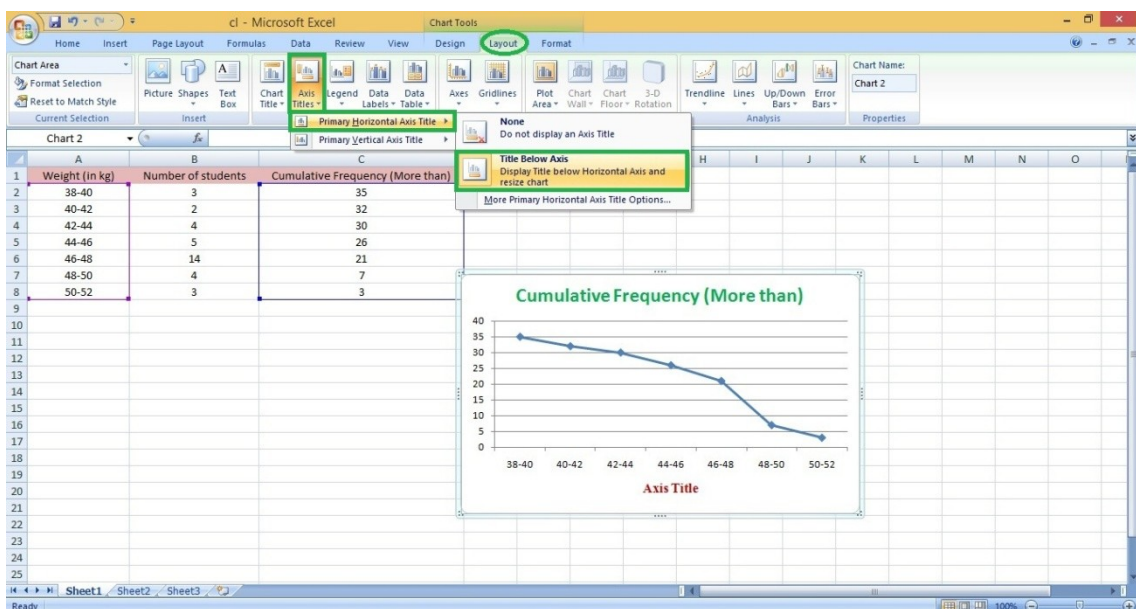


Step 7- Add Chart Elements

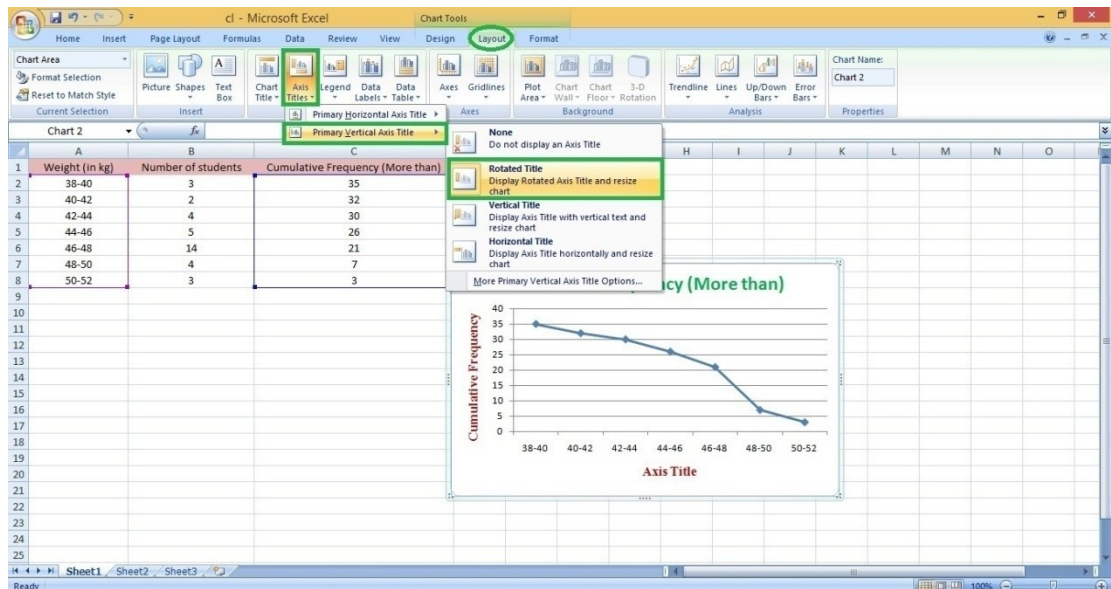
Adding chart elements to the chart or graph will enhance it by clarifying data or providing additional context.

❖ To Add Axis Title:

- To create horizontal axis title, click on 'Layout' tab and choose the option 'Axis Title.' Select the 'Primary Horizontal Axis Title' and 'Title Below Axis' respectively from the dropdown menu. A text box will appear on the chart.

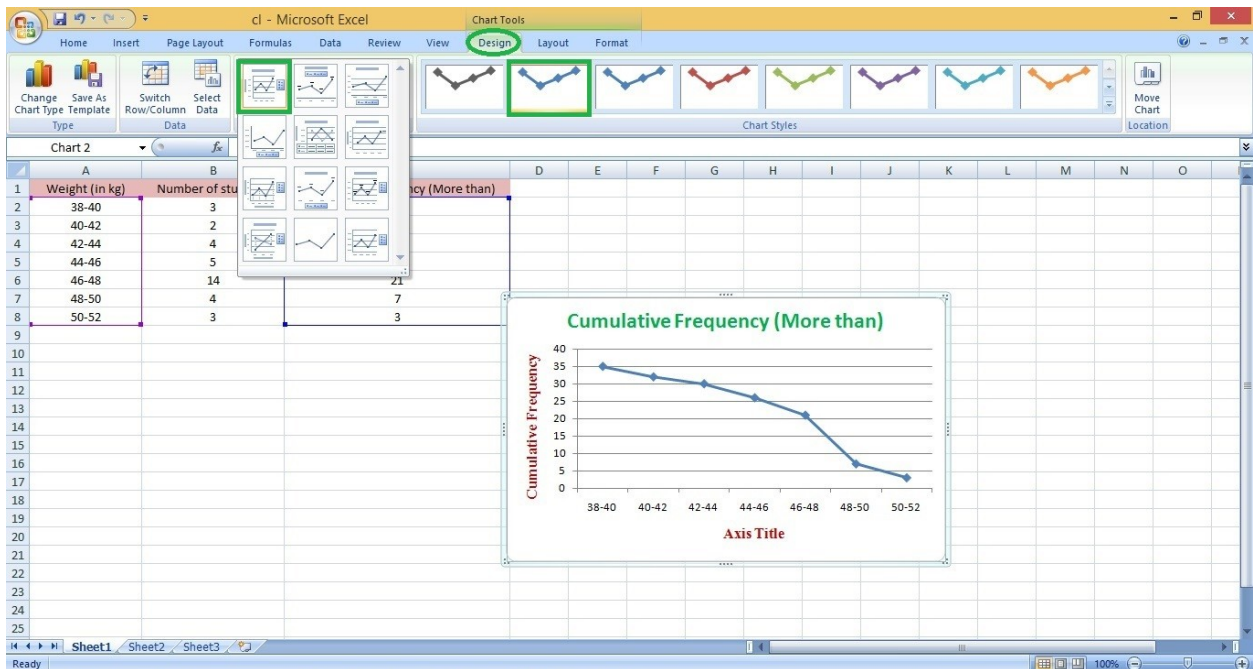


- b. To create vertical axis title, click on 'Layout' tab and choose the option 'Axis Title.' Select the 'Primary Vertical Axis Title' and 'Rotated Title' respectively from the dropdown menu. A text box will appear on the chart.



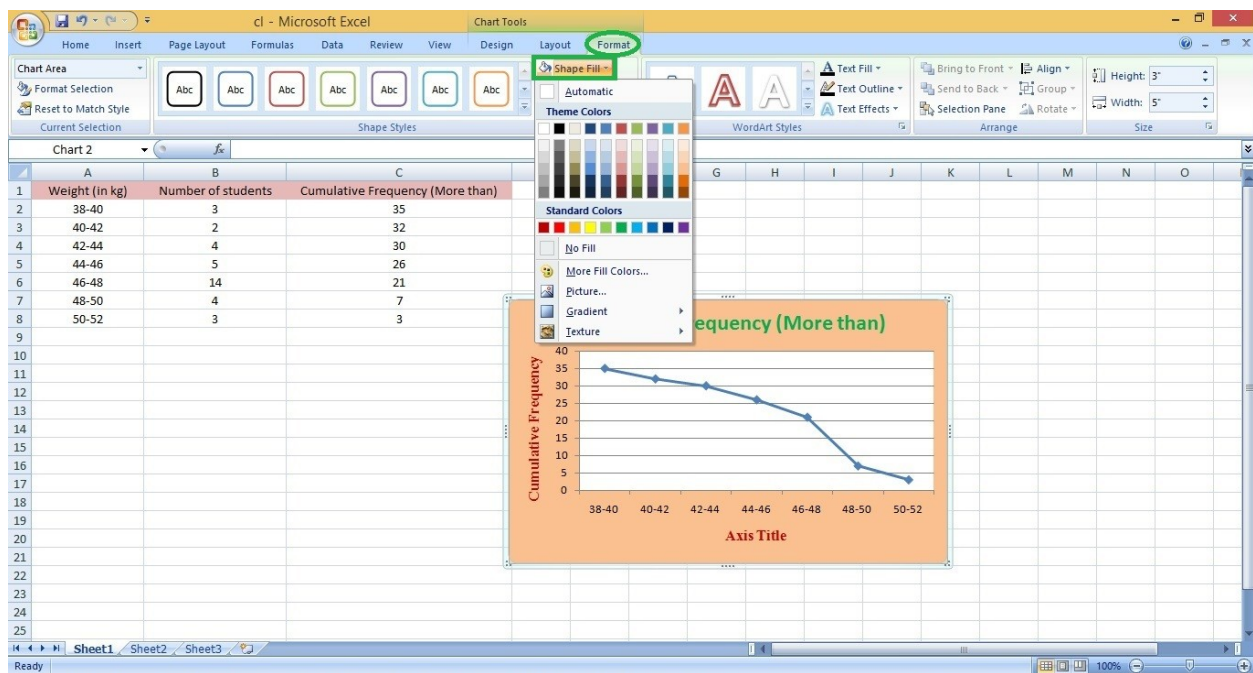
Step 8- Adjust Quick Layout

Click on 'Design' tab to select different layout of graph from the dropdown menu.



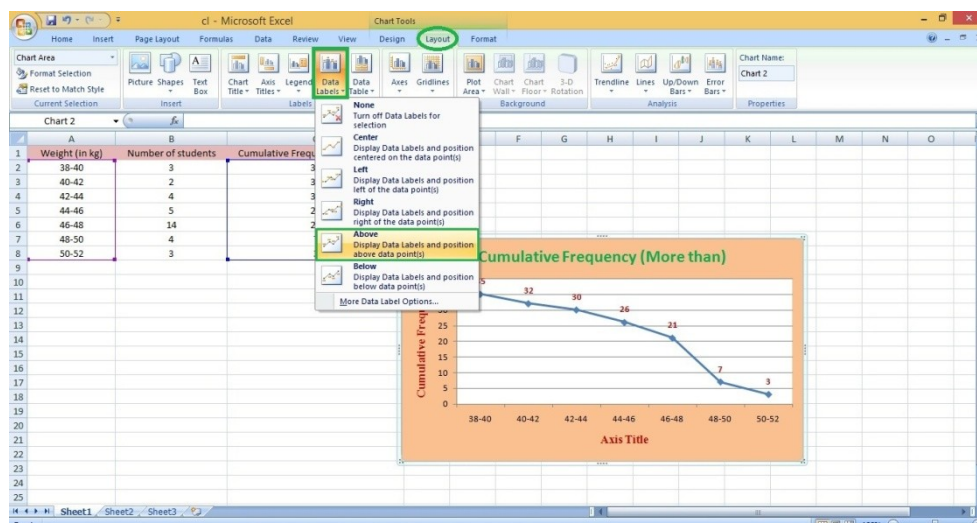
Step 9- Change Formatting

The 'Format' tab allows to change formatting of all elements and text in the chart, including colors, size, shape fill and alignment. Click on 'Format' tab and choose 'Shape Fill' option to format the chart.

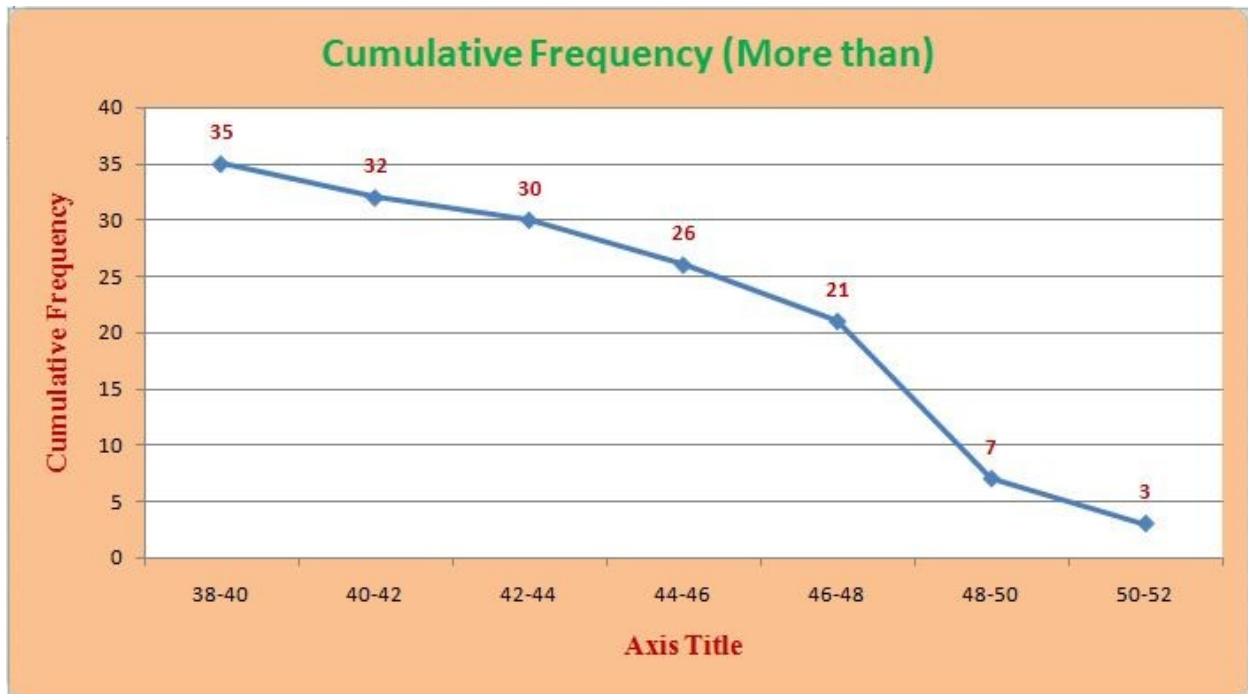


Step 10- To Add Data Labels:

Click on 'Layout' tab and click on 'Data Label.' There are seven options for data labels: None (default), Centre, Left, Right, Above, Below, and More Data label Title Options. Select anyone of them according to choice.



Step 11- Final 'Cumulative Frequency Curve (More than)'.



Frequency Polygon

- ✓ A frequency polygon is a graph that is constructed by joining the midpoint of the intervals.
- ✓ The height of the interval or the bin represents the frequency of the values that lie in that interval.
- ✓ A frequency polygon is almost identical to a histogram, which is used to compare sets of data or to display a cumulative frequency distribution.
- ✓ It uses a line graph to represent quantitative data.
- ✓ Frequency polygons are a visually substantial method of representing quantitative data and its frequencies.

Steps to Draw Frequency Polygon

To draw frequency polygons, first we need to draw histogram and then follow the below steps:

Step 1- Choose the class interval and mark the values on the horizontal axes.

Step 2- Mark the mid value of each interval on the horizontal axes.

Step 3- Mark the frequency of the class on the vertical axes.

Step 4- Corresponding to the frequency of each class interval; mark a point at the height in the middle of the class interval.

Step 5- Connect these points using the line segment.

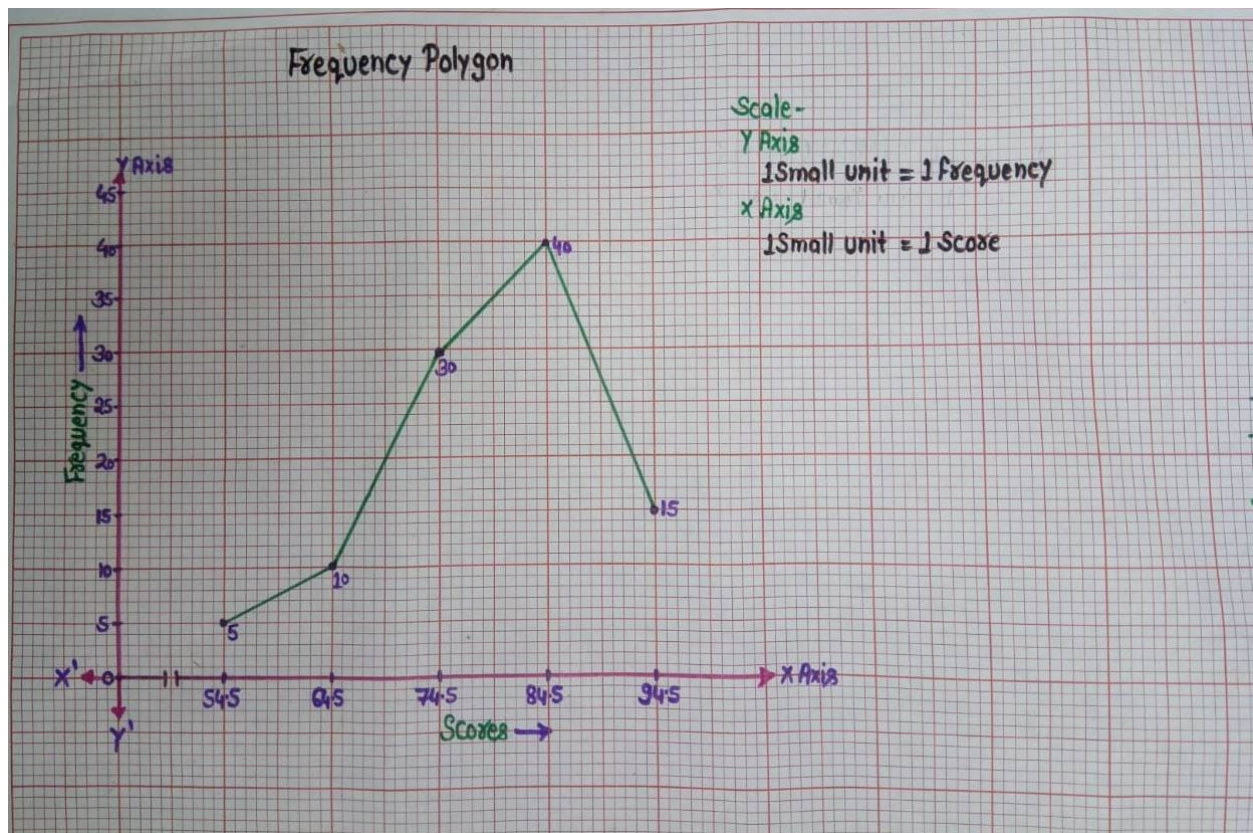
Step 6- The obtained representation is a frequency polygon.

Example:

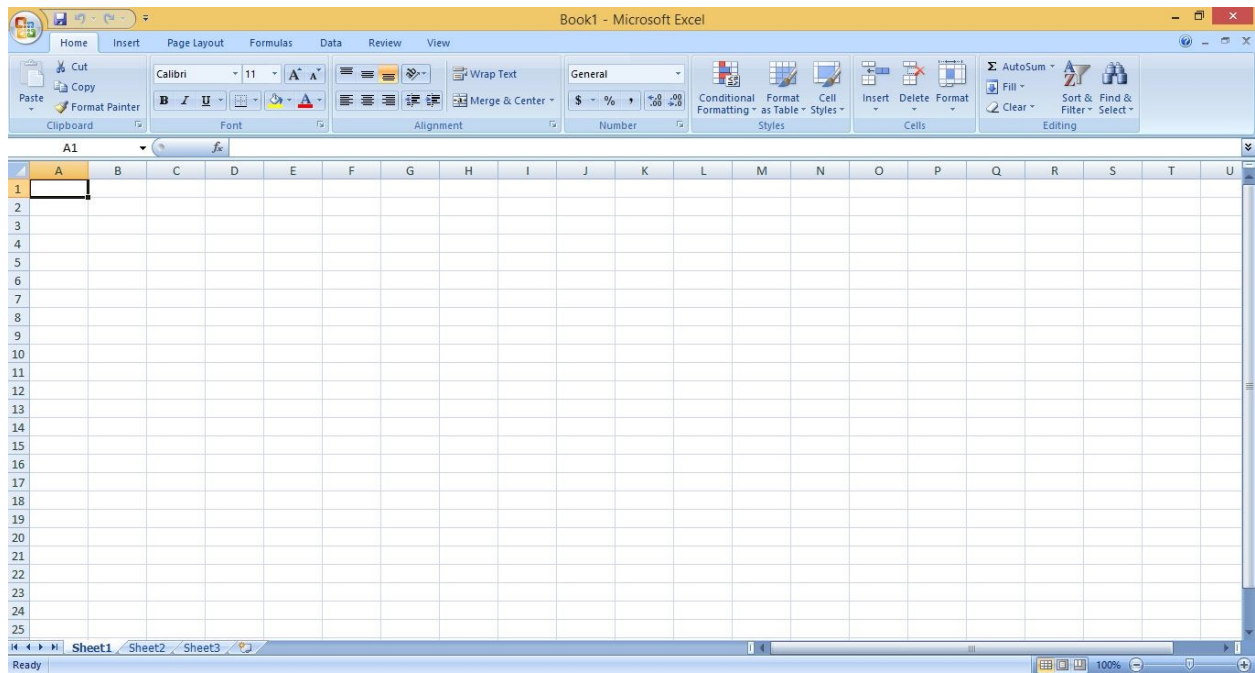
Construct a frequency polygon using the data given below:

| Test Scores | 49.5-59.5 | 59.5-69.5 | 69.5-79.5 | 79.5-89.5 | 89.5-99.5 |
|-------------|-----------|-----------|-----------|-----------|-----------|
| Frequency | 5 | 10 | 30 | 40 | 15 |

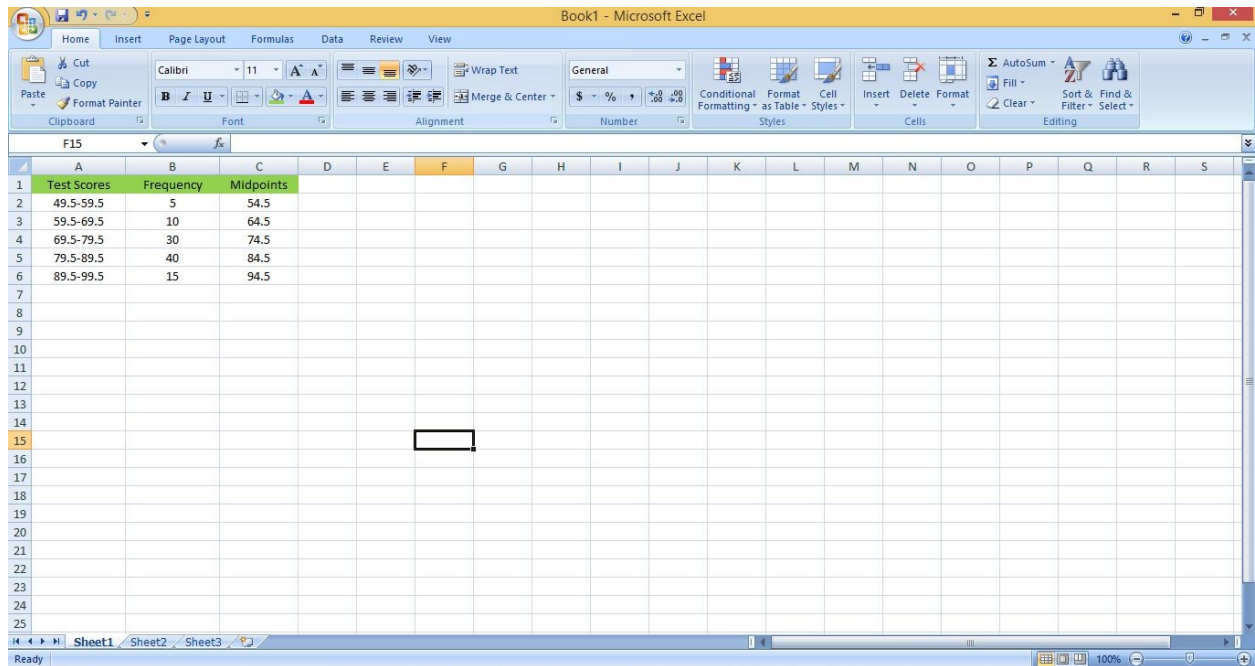
Answer-



Step 1- Open ‘MS Excel’ and select ‘New Workbook’.

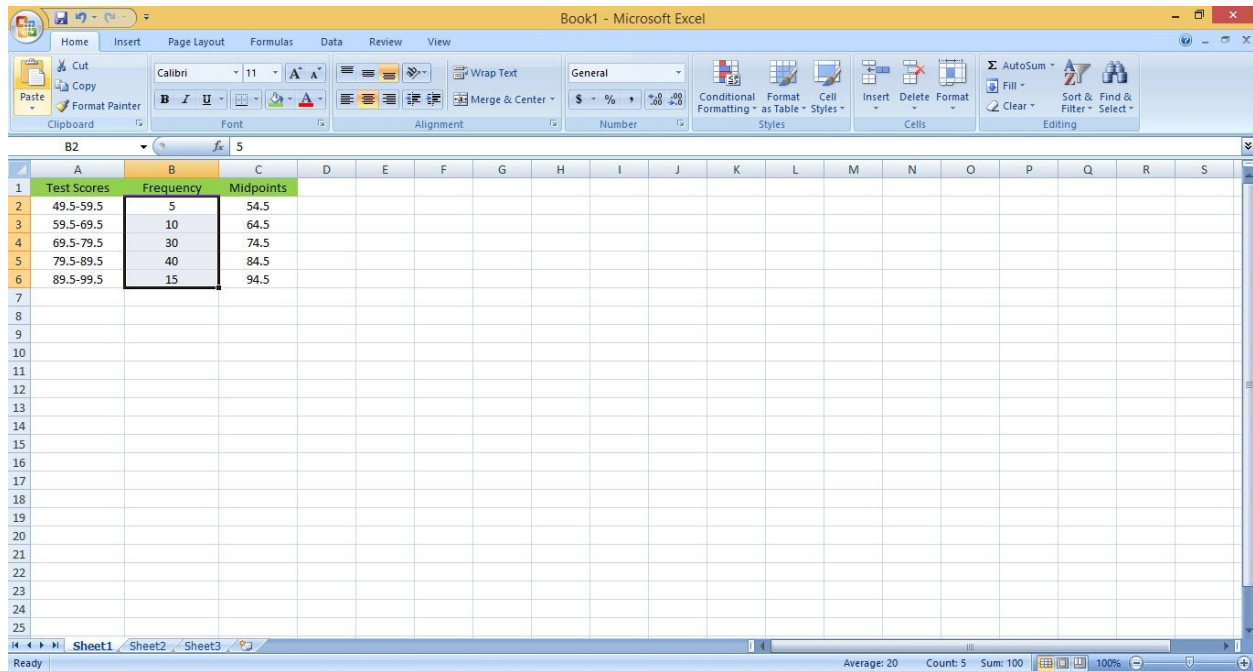


Step 2- Enter the data labels for columns and rows.



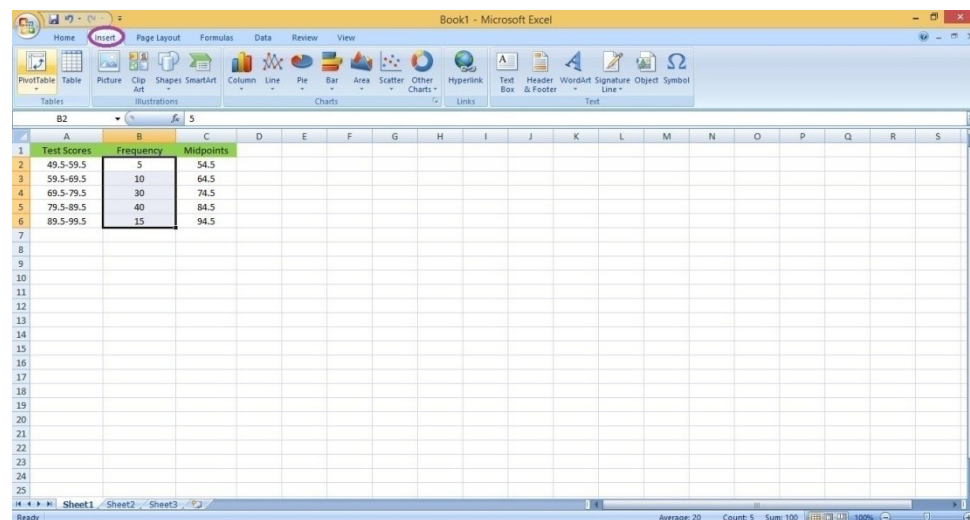
Step 3- Select Range

1. Highlight the cells that contain the data by clicking and dragging mouse across the cells.
2. The cell range will now be highlighted in gray and a chart type can be selected.

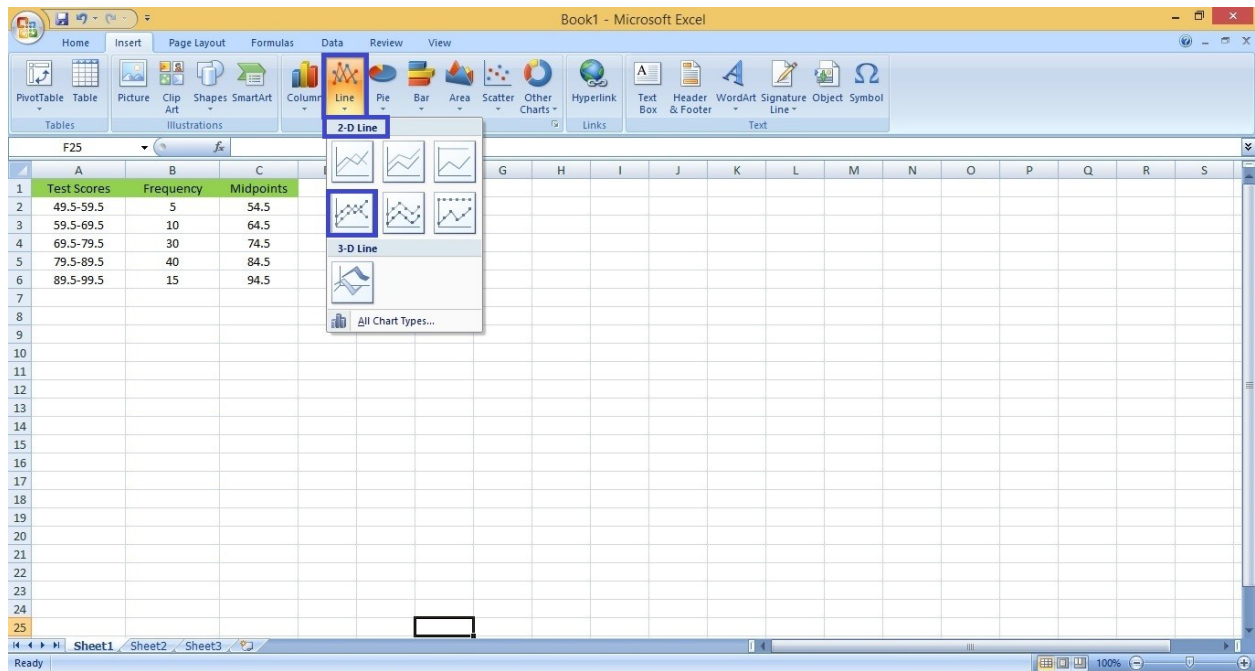


Step 4- Select Chart type

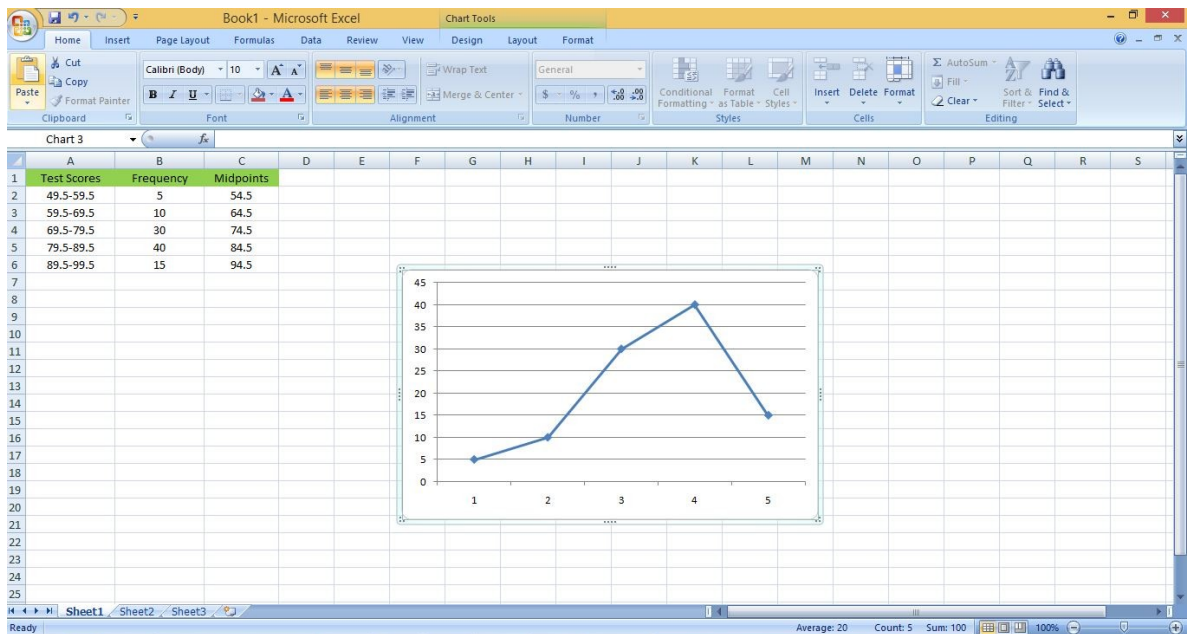
- Click the 'Insert' tab on the top banner. About halfway across the toolbar is a section with several chart options. Excel provides different charts that can be selected by clicking any of the dropdown menus.



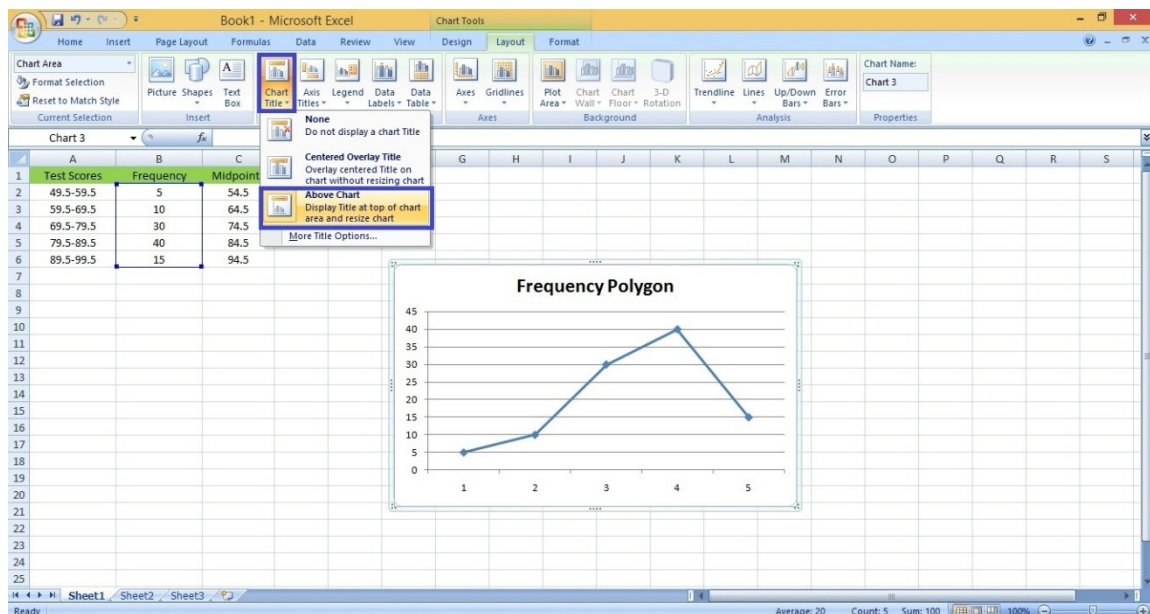
Step 5- Click the ‘Line Chart’ icon and select ‘2-D Line.’



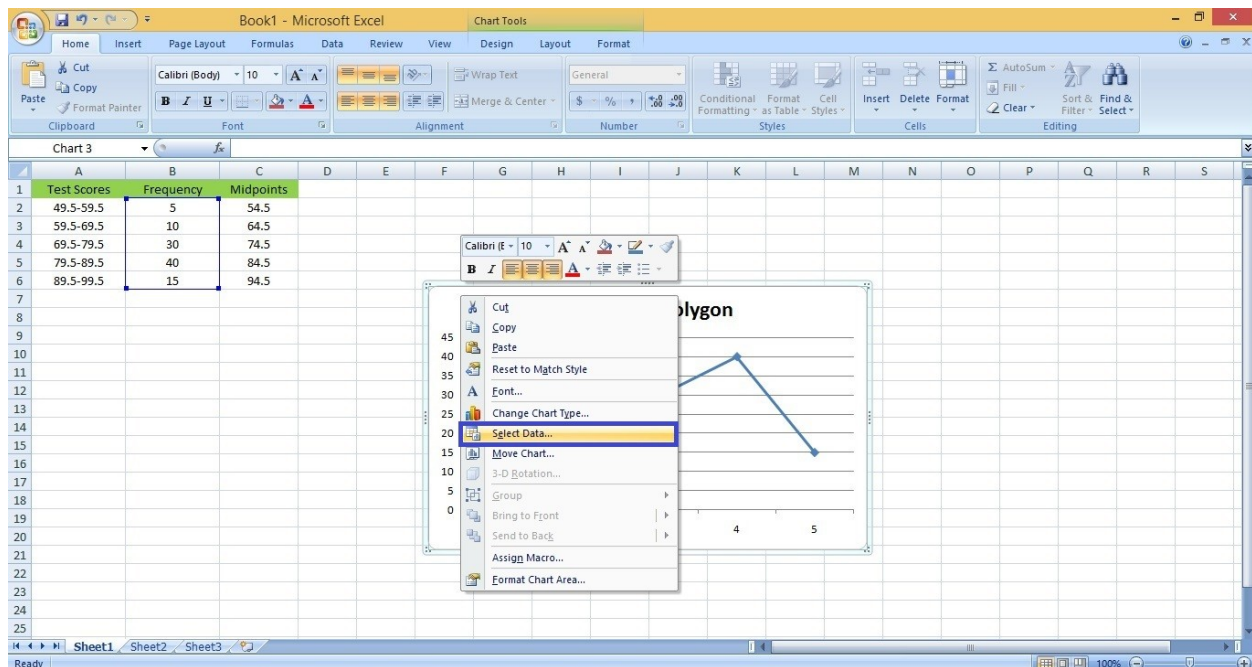
- Excel will automatically create a ‘2-D Line Chart’ from the selected data. The chart will appear in the centre of the workbook.



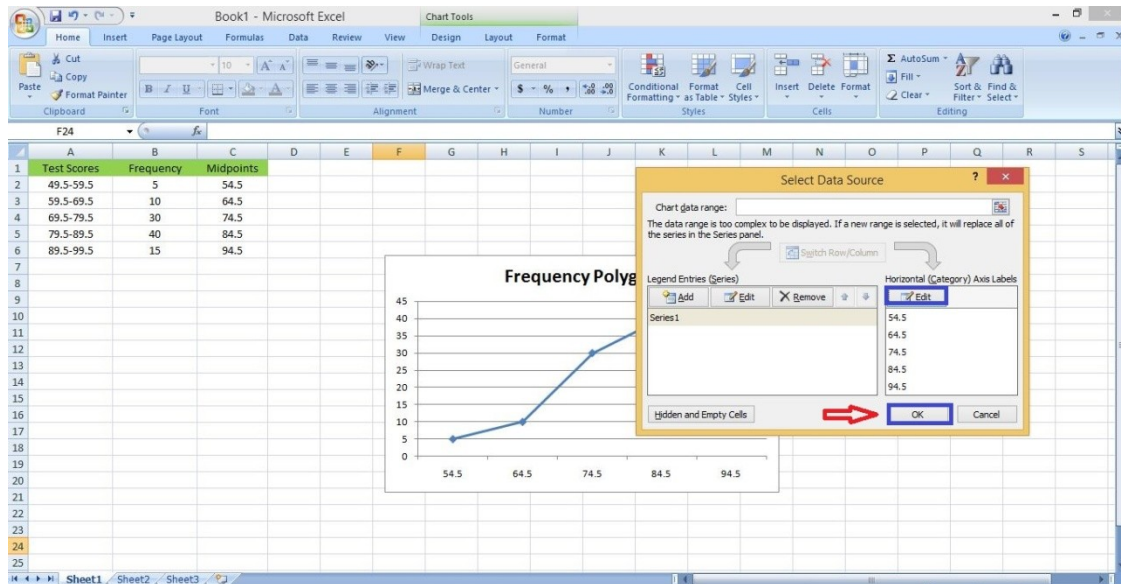
- To name the chart, click on 'Layout' tab and choose the option 'Chart Title' and select the 'Above Chart' from the dropdown menu.



Step 6- Right click the mouse on the inserted graph and choose the option 'Select Data'.



- Click on 'Edit' to fill the horizontal axis data.

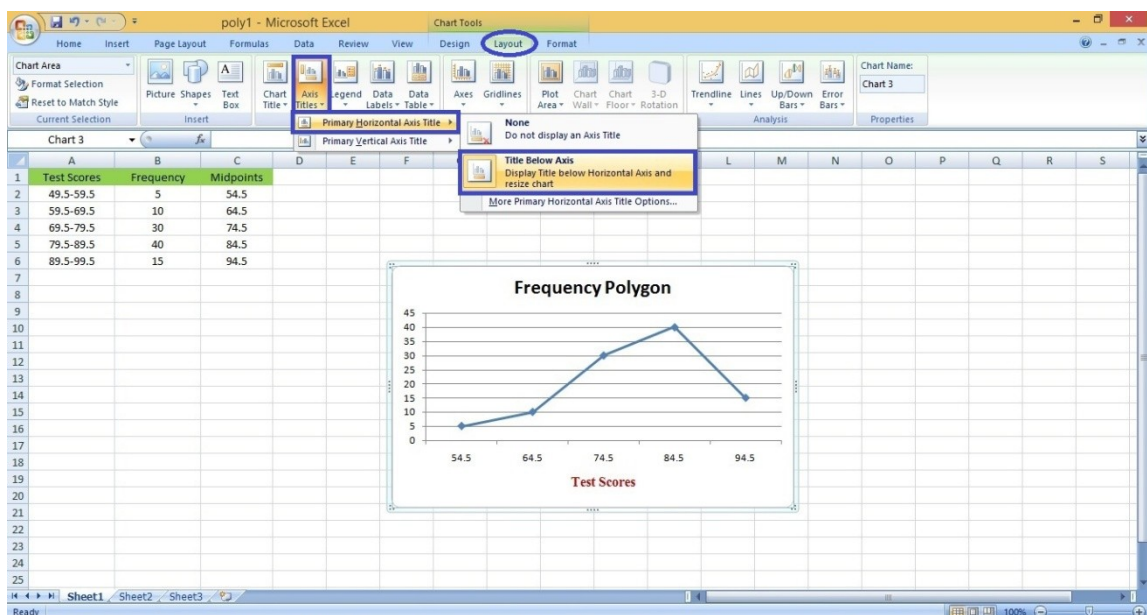


Step 7- Add Chart Elements

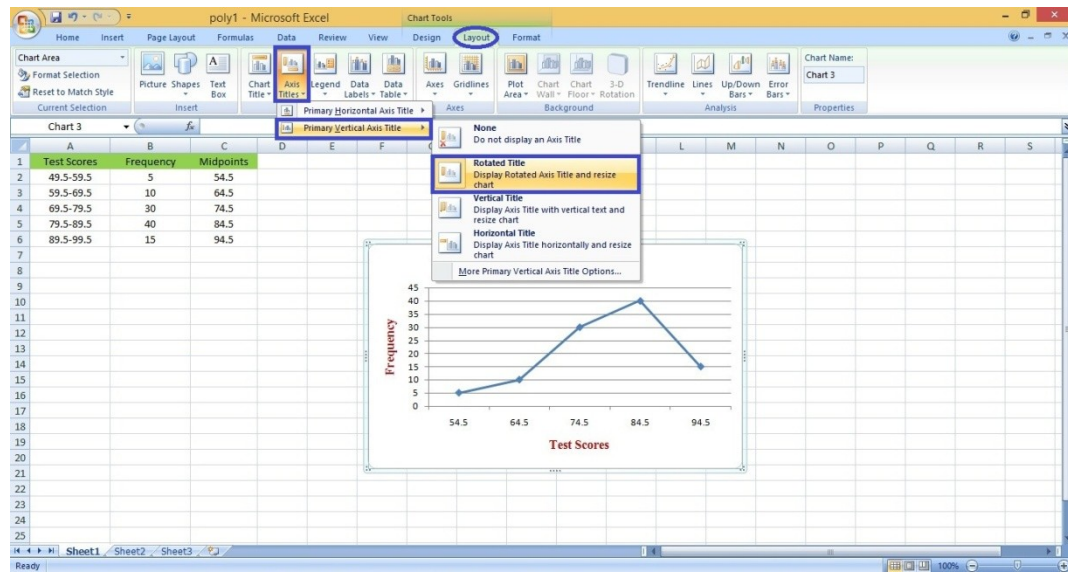
Adding chart elements to the chart or graph will enhance it by clarifying data or providing additional context.

- To Add Axis Title:

- To create horizontal axis title, click on 'Layout' tab and choose the option 'Axis Title.' Select the 'Primary Horizontal Axis Title' and 'Title Below Axis' respectively from the dropdown menu. A text box will appear on the chart.

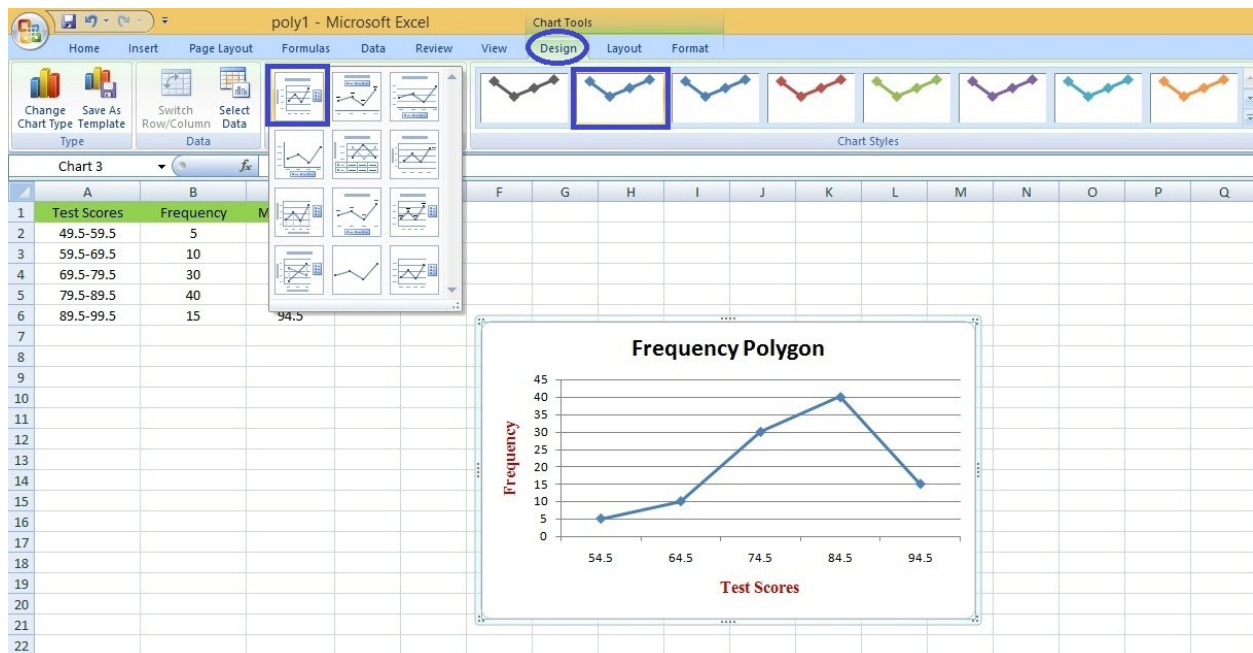


- To create vertical axis title, click on 'Layout' tab and choose the option 'Axis Title.' Select the 'Primary Vertical Axis Title' and 'Rotated Title' respectively from the dropdown menu. A text box will appear on the chart.



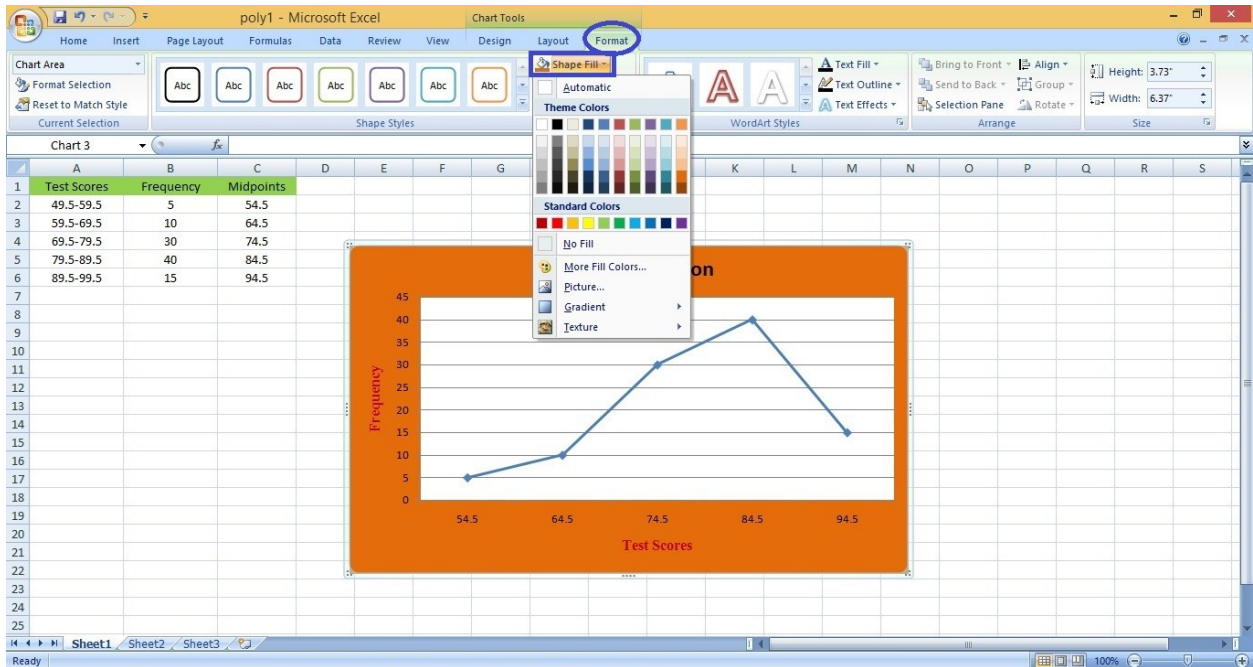
Step 8- Adjust Quick Layout

Click on 'Design' tab to select different layout of graph from the dropdown menu.



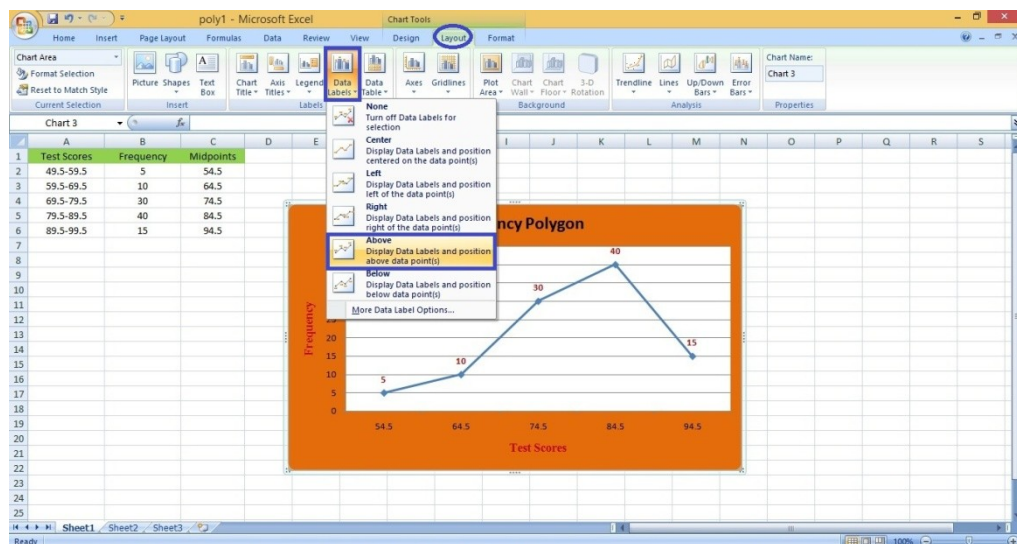
Step 9- Change Formatting

The 'Format' tab allows to change formatting of all elements and text in the chart, including colors, size, shape fill and alignment. Click on 'Format' tab and choose 'Shape Fill' option to format the chart.

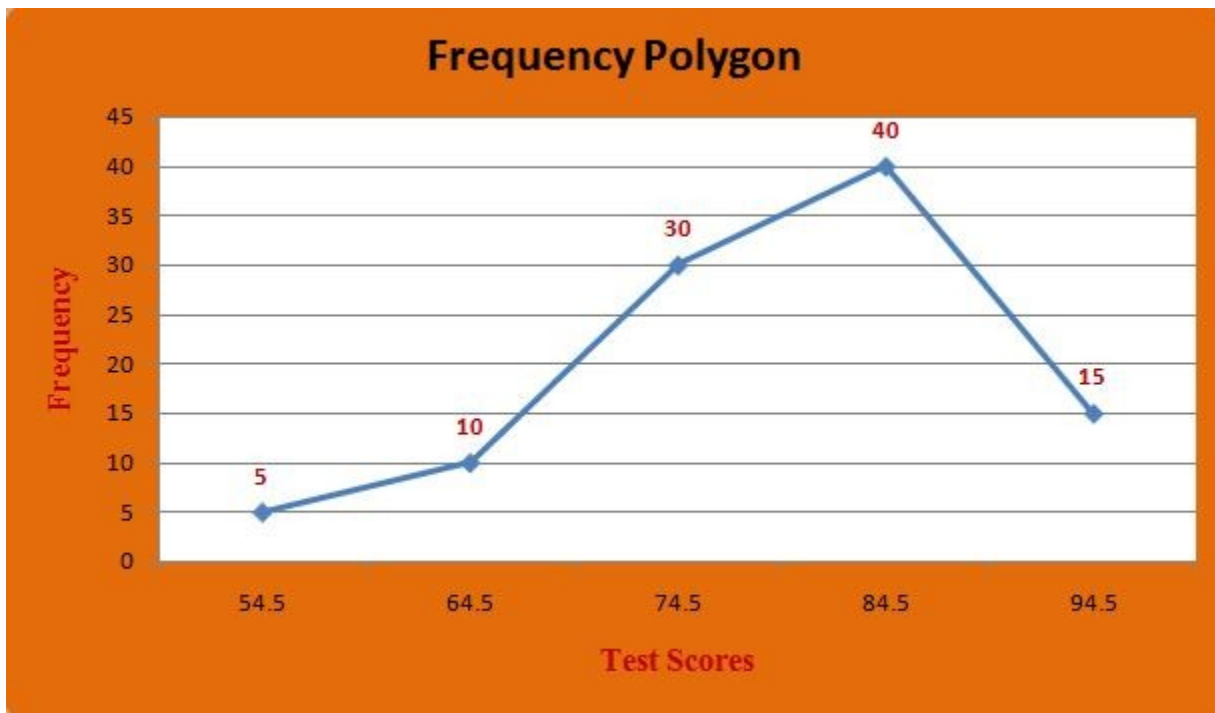


Step 10- To Add Data Labels:

Click on 'Layout' tab and click on 'Data Label.' There are seven options for data labels: None (default), Centre, Left, Right, Above, Below, and More Data label Title Options. Select anyone of them according to choice.



Step 11- Final 'Frequency Polygon' graph.



Conclusion-

Much of what has been said here is both obvious and often easy to implement, it simply requires a little thought and some care to be taken with the construction of figures. Plotting graphs using a computer has the disadvantage that we may be limited by what the computer allows us to do, but it has the advantage that figures can be plotted, altered and replotted very rapidly so we can experiment with presentation to get an effective result. We don't need to accept the first thing the computer throws at us- indeed in most cases it would be a thoroughly bad idea to do so!

Graphical presentation of data is about generating insights into the relationships and patterns in data, and clearly communicating those insights and results to others. The ideas discussed here are not rules that will guarantee successful graphics, but suggestions towards that end. If effective communication in a particular situation requires a different approach then effective communication should be the guiding principle. However, it is worth being aware that

biologists can be as conservative as anyone and that some areas of biology have their own styles and conventions which may be preferred or even enforced. So look at the methods of presentation used in the field in which we are working.

Reference



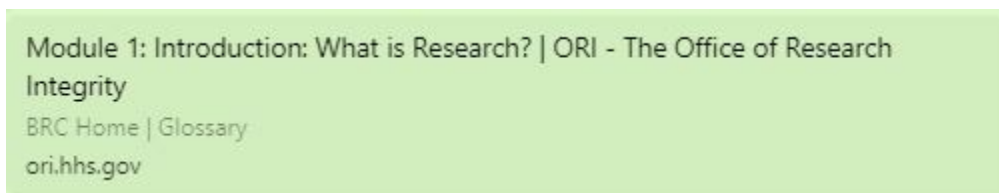
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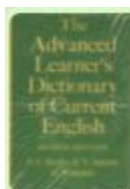
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Steps of the research process

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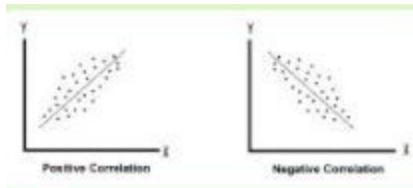
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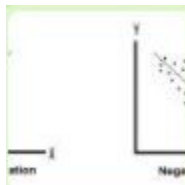
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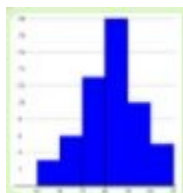
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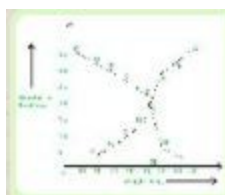
Definition: Inferential statistics is a statistical method that deduces from a small but representative sample the characteristics of a bigger population. In other words, it allows
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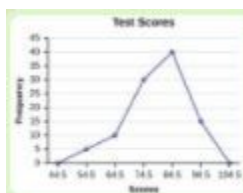
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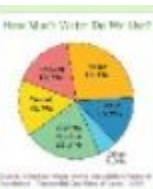
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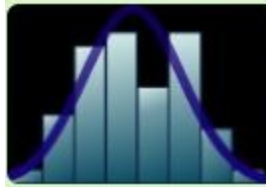
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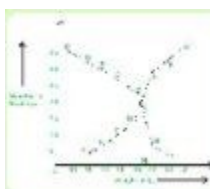
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